

Rare Plants of Bighorn Canyon National Recreation Area

Prepared for the
National Fish and Wildlife Foundation
and
Bighorn Canyon National Recreation Area,
National Park Service

by
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Executive Summary

We conducted systematic surveys of Bighorn Canyon National Recreation Area (NRA) and documented new records for 17 of 25 rare plant species known or suspected to occur in the area.

Six globally rare species were found in the NRA, of which five are sufficiently rare to warrant special management attention. For three of the species, Bighorn Canyon NRA is one of the few areas where they occur that is managed primarily for natural and wildlife values, and is critical to their long-term viability. They include:

- Bighorn fleabane (*Erigeron allocotus*; global rank - G3)
- Persistent-sepal yellowcress (*Rorippa calycina*; global rank - G3)
- Hairy prince's-plume (*Stanleya tomentosa* var. *tomentosa*; global rank - G3T3).

Based on survey results, we also identified key tasks that advance the conservation of rare plant species in Bighorn Canyon NRA:

- Control noxious weeds.
- Evaluate the effects of management actions on the five globally rare species in the course of planning.
- Initiate monitoring of three species
- Identify the most vulnerable habitats of globally rare species as places of special management concern

This report summarizes information on the identification, biology, habitat, and distribution of the 25 globally and state rare plant species that are within the Bighorn Canyon NRA. These data are intended to help resource managers develop and prioritize management and monitoring plans and to identify important concentrations and habitats of rare species. It also contributes to evaluation of rare plant conservation priorities rangewide and statewide.

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Appendices

- Appendix A. Globally and state rare vascular plant species considered as inventory targets in Bighorn Canyon National Recreation Area
- Appendix B. Draft Update to the Flora of Bighorn Canyon National Recreation Area

Introduction

Bighorn Canyon National Recreation Area (NRA) established in 1966 to promote recreational opportunities on the soon-to-be created Yellowtail Reservoir to protect historical sites including the Mason-Lov Ranch and Bad Pass Trail. As a unit of the National Park Service, Bighorn Canyon is also managed to conserve both common and rare native plants and animals (USDI National Park Service 1988). Although a vegetation survey (Knight et al. 1987) and florist survey (Lichvar et al. 1984, 1985) have been conducted in Bighorn Canyon, little attention has been directed towards the management of rare plant species in the NRA. To help resolve this problem, the National Park Service and the National Fish and Wildlife Foundation contracted with the Montana Natural Heritage Program and the Wyoming Natural Diversity Database in 1998 to assemble information on the distribution, relative abundance, habitat, and management needs of rare plant species found in the Bighorn Canyon. The study results are contained in this report.

Study Area

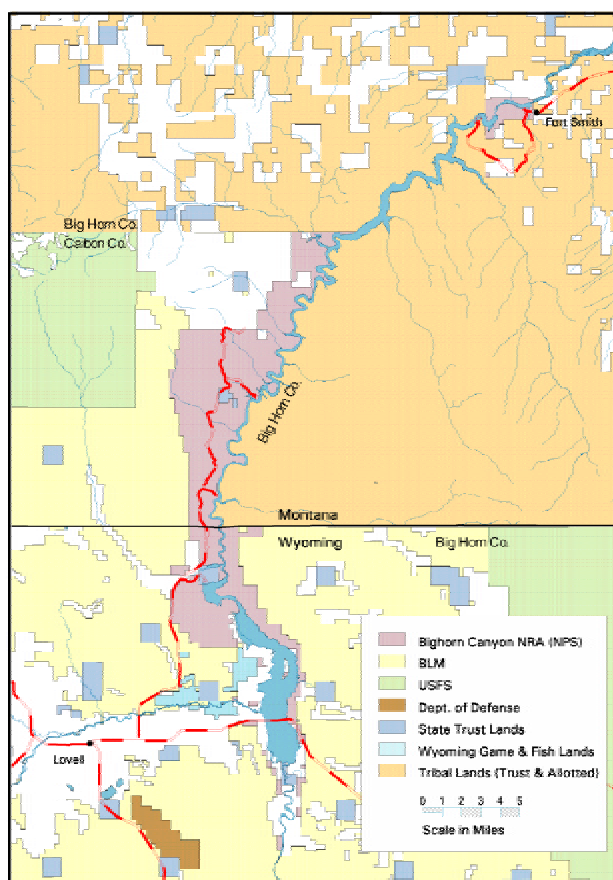
Setting

The Bighorn Canyon National Recreation Area (NRA) spans a north-south distance of approximately 113 km (70 miles) along the Bighorn River, straddling the Montana-Wyoming state line. It encompasses a land area of 22,499 ha (55,595 acres) plus approximately 5,140 ha (12,700 acres) of water. It is administered by the National Park Service (NPS) out of offices in Lovell, WY and Fort Smith, MT, and is surrounded by federal, tribal, state, and private lands (Figure 1).

Bighorn Canyon is the defining feature in this landscape, with sheer cliff faces along much of its length. The Bighorn River carved much of the canyon, but its flow is impeded today by Yellowtail Dam. This entire river channel segment is now occupied by Yellowtail Reservoir.

The NRA bisects three major North American ecoregions: Bighorn Basin Section, Bighorn Mountains Section, and Powder River Basin Section (Figure 2; Bailey et al. 1994). They are affected differently by the adjoining Bighorn Mountains to the east, and the Pryor Mountains to the west, in terms of their

Figure 1. Bighorn Canyon NRA study area



rainshadow effects and landscape continuity. The juxtaposition of these ecoregions helps account for the high species richness and diversity of vegetation types found in Bighorn Canyon NRA. More detailed description of the study area environment is provided in Knight et al. (1987).

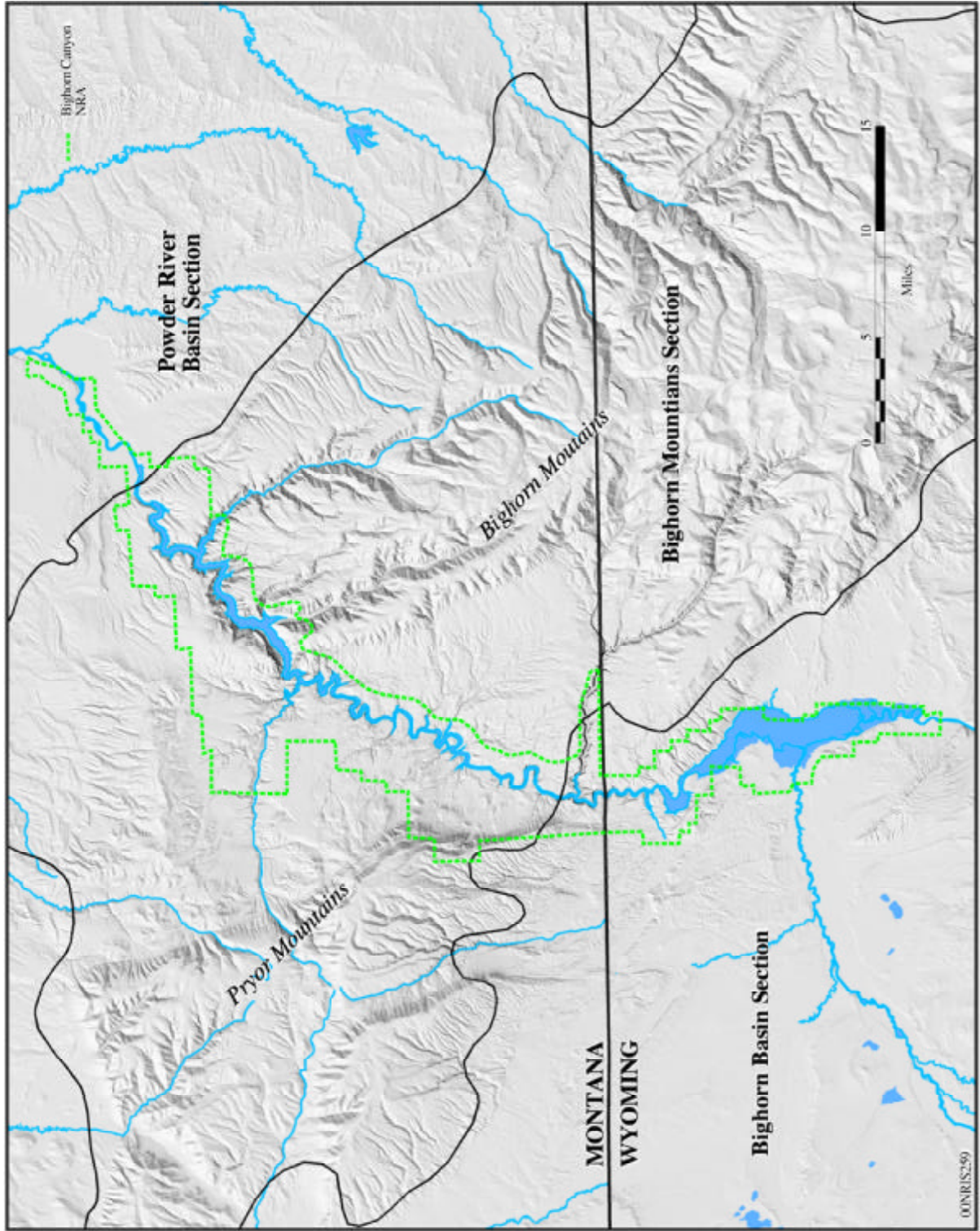
Bighorn Canyon National Recreation Area operates under a general management plan (USDI National Park Service 1981) in which management zones and subzones are delimited. Large areas of the study area fall within the “Natural Zone” which contains the most intact habitat. The following zones and subzones were considered in this study insofar as they fall within NPS administration or purview, and provide potential habitat for rare plants.

Natural Zone: Natural Environment, Wildlife Preservation, and Protected Natural Area subzones

Park Development Zone: (facilities, access developments)

Special Use Zone: Reservoir, Mining, Wildlife Management, Utilities, and Transportation subzones

Figure 2. Topography of Bighorn Canyon NRA area

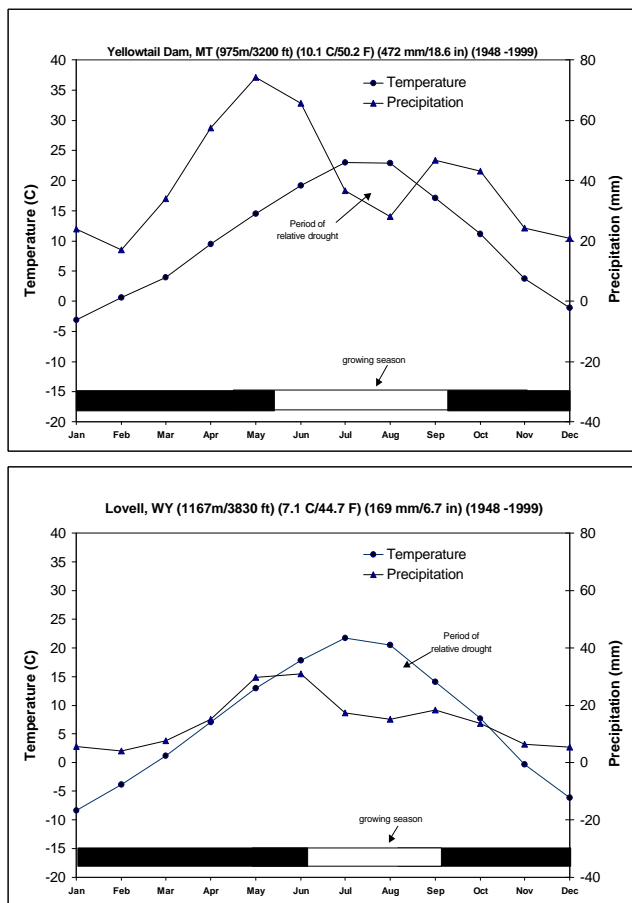


Climate

Bighorn Canyon NRA encompasses a range of climates along its length. The mean annual precipitation ranges from 17.0 cm (6.7 in) at its south end in Lovell, WY (NOAA records, 1948-1999) to 48.9 cm (18.9 in) at Yellowtail Dam, MT (NOAA records, 1948-1999).

The south end of the study area has a cold desert climate with a long period of relative drought. Lovell records may not represent the lowest mean annual rainfall values in the study area as found in the Pryor Mountains Desert of the Horseshoe Bend area. The north end of the study area, by contrast, has a mild foothills climate with high rainfall in the spring and a longer growing season (Figure 3).

Figure 3. Climate diagrams for Yellowtail Dam, MT and Lovell, WY, showing average monthly temperature and precipitation near north and south ends of Bighorn Canyon NRA. Growing season length is the number of frost-free days, i.e., with mean daily minimum above 0 degrees C.



Geology and Landforms

The Big Horn River follows a structural sag extending northward out of the Bighorn Basin. The Bighorn Mountains developed as a deep Laramide thrust fault and the Pryor Mountains as a fault block during regional uplifting about 50 million years ago (Alt and Hyndman 1986). More regional uplifting occurred over a prolonged period about 10 million years ago, allowing the Bighorn River to deeply incise its course into sedimentary beds of Paleozoic bedrock. Topographic relief ranges from 1114 – 2414 m (app. 3657-7920 ft). Paleozoic marine limestones are some of the most extensive and exposed outcrops on both the walls of the Canyon and the East Pryor Mountains escarpment (Richards 1955; discussed in Knight et al. 1987). Vast areas of the Bighorn Canyon are mantled by Tensleep Sandstone and Amsden Formation with beds of shale, red siltstone, and sandstone. Many springs and seeps are found where permeable sandstone overlies less permeable layers between the Hillsboro and Davis Ranches; and again above the rim of the Canyon south of Yellowtail Dam.

Perennial streams are few in this landscape, and many of the previously-mentioned springs and seeps disappear belowground before reaching the Bighorn River. The Shoshone River is the largest tributary of the Bighorn River, entering it in the open plains at the south end of the study area. The Porcupine Creek is the largest tributary within the Canyon. Cold-water tributaries include the Big Bull Elk Creek, East Cabin Creek, and Black Canyon Creek, at the northern end where the Canyon cuts through the Bighorn anticline.

Vegetation

The Bighorn Canyon NRA landscape is an open panorama where desert shrublands prevail at the southern end, arid woodlands cover vast expanses in the middle, and the landscape finally gives way to grassland at the far northern end. The canyon slices through and dissects the landscape; the deciduous woodland and other riparian vegetation types are confined to reservoir margins, tributaries and draws. Tall-stature conifer woodlands and forests are restricted to relatively mesic upland slopes, side-valleys and breaks on the Montana side. High plateaus, outwashes and ridges have grasslands or sagebrush steppe. Bighorn Canyon vegetation cover types are listed on the following page by their relative extent based on the preliminary mapping work of Myers et al. (1986):

Juniper and mountain mahogany woodlands	40%
Riparian vegetation (includes meadows, flats)	16%
Desert shrubland	15%
Sagebrush steppe	12%
Grasslands	8%
Coniferous woodland/forest	6%

This does not include the open water reservoir habitat that makes up over 18% of the total Bighorn Canyon NRA surface area. There are no human landscape alterations of similar magnitude in the uplands; only 1.7% of the land area has been plowed and used as agricultural land.

Flora

The diverse habitats of Bighorn Canyon NRA are reflected in its rich flora, which includes Great Basin species at the northern limits of their range, Rocky Mountain species, Great Plains species, a few eastern deciduous woodland species, regional endemics, and introduced species. A floristic overview is represented in Lichvar et al. (1985). The collections that were reported in this publication and over 30 species subsequently collected by NPS personnel are represented in the NPS database (USDI National Park Service 1998). Over 70 species were added in the course of this study to the NPS database (Table 1).

Table 1. Summary of the flora of Bighorn Canyon National Recreation Area

Taxonomic level	Tally in Lichvar et al. (1985)	Updated tally (NPS 1998 and this study)
Family	73	79
Genus	320	337
Species/ subspecific ranks	656	776*

* This tally includes species collected by NPS personnel since Lichvar et al. (1985), collected by Lichvar et al. but not reported, and collected or observed in this study. The NPS collection additions may include synonyms with the Lichvar et al. checklist. It does not include at least 22 more species reported in vegetation plots of Knight et al. (1987) that are probably part of the flora. There are also up to 23 specimens that have been annotated and which need to be subtracted from these tallies. Editing, curation, and additional collecting is warranted in producing a baseline flora.

Methods

Species were selected for field surveys by the Montana and Wyoming heritage programs based on global rarity, local or regional endemism, and state rarity. Highest priority was given to those species with limited geographic ranges (e.g., *Lesquerella lescii*, *Eriogonum brevicaulle* var. *canum*), low population sizes (*Stanleya tomentosa* var. *tomentosa*), or specialized habitats (*Rorippa calycina*). Other species considered rare in one or both states, but not in jeopardy globally, were also surveyed (Appendix A). The list included all species previously documented in the study area, or with potential habitat in the study area based on available distribution and habitat information. They include species that are tracked as species of special concern or watch species, the latter including species of limited distribution and recent additions to the state flora under consideration for adding to the list of tracked species. Status review was built into the methods, and altogether a total of 55 species were targeted for survey over the course of the project.

Surveys were conducted in the summers of 1998 and 1999. Prior to conducting fieldwork, we assembled information on the biology, habitat needs, and known distribution of target species from heritage databases, published and unpublished literature, and herbarium specimens. Aerial photographs (black-and-white 10"/mile-1954, black-and-white 5"/mile-1954, and color 3"/mile-1978), USGS topographic maps, and geologic and vegetation maps were consulted to identify areas of potential habitat for ground survey. Bighorn Canyon NRA staff also provided valuable input on potential survey sites and their accessibility.

In the field, we collected data on the biology, habitat, population size, and potential management needs of the target species. Locations of rare plants were mapped on 7 ½ minute topographic quads. Information gathered in the field was entered into the computerized element occurrence database maintained by each state heritage program. Mapped locations were digitized into GIS coverages, including both point and polygon data.

Voucher specimens were collected for rare species and for documenting additions to the flora if the species was not already represented by specimens. Specimens

and accompanying label data are being submitted to the herbaria at Bighorn Canyon (BHC), University of Wyoming (RM) or University of Montana (MONTU). A working list of the study area flora was maintained, and additions to it were recorded in a copy of the NPS database noting repository and collection numbers (Appendix B). Photographs were also taken of species of concern and their habitats.

Fieldwork was conducted using current state floras as references (Dorn 1984, 1992). Nomenclature in this report follows the taxonomic conventions in these floras; similar to the original Bighorn checklist (Lichvar et al. 1985). Regional floras were used in the field for more detailed keys and descriptions (Hitchcock and Cronquist 1973, Great Plains Flora Committee 1986), and more detailed treatments and monographs were consulted as needed in processing collections.

Results

Six globally rare species were documented in Bighorn Canyon NRA, representing species of restricted distribution as local or regional endemics. Of these globally rare species, Rabbit buckwheat (*Eriogonum brevicaule* var. *canum*) was found to be locally abundant and sufficiently widespread throughout the NRA to be considered secure under present management. Another of the species, Lesica's bladderpod (*Lesquerella lesicii*), barely enters the NRA, and is otherwise restricted to BLM-administered lands. For the other four globally rare species, Bighorn Canyon NRA has high numbers and is critical to their long-term survival. In total, 25 plant species of concern recognized by the Montana or Wyoming natural heritage programs are known from Bighorn Canyon NRA (Table 2), and we documented new populations for 17 of the 25 species.

The 19 "state priority" plants are mostly species at the northern or western margins of their distribution. These are mostly species that are rare in Montana but more common in Wyoming. Only the Sheathed musineon (*Musineon vaginatum*), a regional endemic, is rare in Wyoming. Its Montana status was evaluated in the course of the study.

Five of the species are new to the Bighorn Canyon NRA flora as represented by the NPS database, including:

- Gray Aster (*Aster glaucodes*);
- Sweetwater milkvetch (*Astragalus aretioides*) collected in 1953 near Bighorn Canyon; presumably outside current NRA boundaries;
- Pregnant sedge (*Carex gravida* var. *gravida*);
- Lesica's bladderpod (*Lesquerella lesicii*), first documented for Bighorn Canyon in Lesica 1995;
- Wind River milkvetch (*Oxytropis besseyi* var. *ventosa*)

In the following section, we present a summary of information on the identification, status, distribution, habitat, abundance, and management needs for 6 globally rare and 19 state rare plants from Bighorn Canyon NRA. They are a management reference for the Bighorn National Recreation Area and partners. This greatly enhances what is known about the respective species in each state, information that will be incorporated in updated field guides to plant species of special concern (Fertig et al. 1994, Montana Natural Heritage Program 1999). It is currently stored in databases that are available through technical services of MTNHP and WYNDD.

Apart from the species summary information, we have expanded the Bighorn Canyon NRA checklist (Appendix B). In addition, we have revised the contents as well as updated state and global ranks of Montana and Wyoming plant species of special concern and annual state list updates of species of special concern. This was most recently completed in 1999 (Fertig and Beauvais 1999, Heidel 1999). Finally, detailed maps and records are provided as hardcopy and electronic files as supplement to this report.

Table 2. Rare vascular plants of Bighorn Canyon National Recreation Area						
Scientific name	Common name	GRANK*	MT-SRANK*	No. in MT	WY-SRANK*	No. in WY
<i>Agrimonia gryposepala</i>	Common agrimony	G5	SU	1	S1	
<i>Arabis demissa</i> var. <i>languida</i>	Daggett rock cress	G4T4	S1	3	S2	
<i>Aster glaucodes</i>	Gray aster	G4G5	S1	1	S3	
<i>Astragalus aretioides</i>	Sweetwater milkvetch	G4	S2	1	S3	
<i>Astragalus geyeri</i> var. <i>geyeri</i>	Geyer's milkvetch	G3G4T3T4	S2	1	S3	P
<i>Astragalus oreganus</i>	Wind River milkvetch	G4?	S1	1	S3	P
<i>Carex gravida</i> var. <i>gravida</i>	Pregnant sedge	G5T?	S1	1	S2	
<i>Cleome lutea</i>	Yellow bee plant	G5	S1	1	S3	P
<i>Delphinium geyei</i>	Geyer's larkspur	G5	S1	2	S4	
<i>Erigeron allocotus</i>	Bighorn fleabane	G3	S3	3 (17)	S2S3	2 (20)
<i>Eriogonum brevicaulis</i> var. <i>canum</i>	Rabbit buckwheat	G3	S3	3 (52)	S2	2 (30)
<i>Eupatorium maculatum</i> var. <i>bruneri</i>	Joe-pye weed	G5TU	S2	3	S2	
<i>Grayia spinosa</i>	Spiny hopsage	G5	S2	1	S3S4S3	P
<i>Leptodactylon caespitosum</i>	Leptodactylon	G3G4	S1	4	S3	P
<i>Lesquerella lescii</i>	Lesica's bladderpod	G1	S1	1	not in WY	
<i>Mentzelia pumila</i> var. <i>pumila</i>	Dwarf mentzelia	G4	S2	2	S3	P
<i>Musineon vaginatum</i>	Sheathed musineon	G3?	S3	4	S2	
<i>Oxytropis besseyi</i> var. <i>fallax</i>	Bighorn locoweed	G5T3	SU	2	S3	P
<i>Oxytropis besseyi</i> var. <i>ventosa</i>	Wind River locoweed	G5T3	SU	1	S3	
<i>Rorippa calycina</i>	Persistent sepal yellowcress	G3	S1	0	S2S3	1 (11)
<i>Senecio eremophilus</i> var. <i>eremophilus</i>	Cut-leaved groundsel	G5T5	S1	1	S3	
<i>Sphenopholis intermedia</i>	Slender wedgegrass	G5	S1	1	S2	
<i>Stanleya tomentosa</i> var. <i>tomentosa</i>	Hairy prince's-plume	G3T3	S3	12	S2	2 (4)
<i>Stipa lettermanii</i>	Letterman's needlegrass	G5	S1	2	S3S4	P
<i>Sullivantia hapemanii</i> var. <i>hapemanii</i>	Wyoming Sullivantia	G3T3	S1	9	S3	

* Rank Definition

A rank prefaced by “G” refers to global rank, i.e. rangewide rank. A rank prefaced by “S” refers to state rank, determined separately from grank but by much the same standards within state boundaries.

- 1 Critically imperiled because of extremeness (usually 5 or fewer occurrences, or very few remaining individuals), or because of some factor of its biology making it especially vulnerable to extinction.
- 2 Imperiled because of rarity (usually 6 to 20 occurrences), or because of other factors demonstrably making it very vulnerable to extinction throughout its range.
- 3 Vulnerable because of rarity (usually 21 to 100 occurrences) or found in a restricted range even though it may be abundant at some of its locations.
- 4 Apparently secure, though it may be quite rare in parts of its range, especially at the periphery.
- 5 Demonstrably secure, though it may be quite rare in parts of its range, especially at the periphery.
- U Possibly in peril, but status uncertain, more information needed.
- H Historical, known only from records over 50 year ago, may be rediscovered.

Globally-rare Plant Species Summaries

Erigeron allocotus Blake Bighorn fleabane Asteraceae (Sunflower Family)

Status

Heritage Rank: Global - G3, Montana - S3 [watch; formerly listed as a species of special concern (Lesica and Shelly 1991), but downlisted to a watch species of limited distribution following the discovery of numerous occurrences in the Pryor Mountains by Lesica and Achuff (1992); Wyoming - S2S3 [Medium conservation priority].

Legal Status: USF&WS - former 3C; BLM (MT) - Watch, BLM (WY) - None. USFS - None.

Description

Bighorn fleabane is a perennial forb with leafy stems 13-18 cm tall surmounting a branched, woody taproot

Figure 4. Illustration of *Erigeron allocotus*



Illustration by Walter Fertig

(figures 4, 5). Stems and leaves are conspicuously pubescent with coarse, spreading hairs. The leaves may also be finely glandular and are divided at the tip into 3-5 teeth or linear segments. Basal leaves are 1.5-3 cm long, while stem leaves are mostly under 1 cm and simple to 3-toothed. Flowering heads are small and numerous, each having a 4-5 mm high involucre of glandular and hirsute bracts, 25-40 white to pinkish ray flowers that are 3-6 mm long, and a yellow-flowered disk 6-9 mm wide with disk corollas 2-3.5 mm long. The pappus consists of 12-20 bristles 2-2.5 mm long. Fruits are 2-nerved achenes with short stiff hairs (Blake 1937, Cronquist 1947, Dorn 1992, Marriott and Jones 1989).

Figure 5. Photo of *Erigeron allocotus*



Photo by Bonnie Heidel

Similar Species: *Erigeron compositus* has short pubescence, leafless (or nearly so) stems, leaf blades cleft into 5-10 narrow segments, and often has fewer and larger flowers. *E. pinnatisectus* has pinnately-divided leaf blades, purple ray flowers, leafless stems, and is not known from the Bighorn Range (Dorn 1992).

Flowering/Fruiting Period: Flowering occurs from May to early July. Fruits are present from June to late July.

Range and Habitat

Range: Bighorn fleabane is a regional endemic of the Bighorn and Pryor mountains and adjacent foothills in north-central Wyoming and south-central Montana. In Montana, it is restricted to the eastern end of the Pryor Mountains and adjoining Bighorn Canyon area in one large area that spans Big Horn and Carbon counties.

Figure 6. Montana and Wyoming county distribution of *Erigeron allocotus*

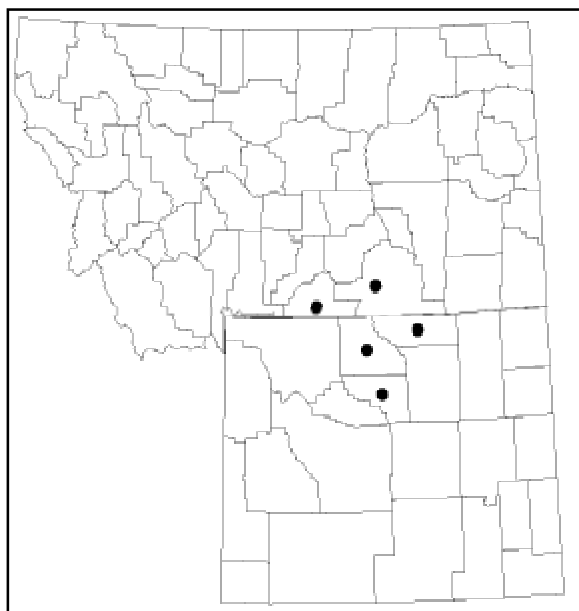
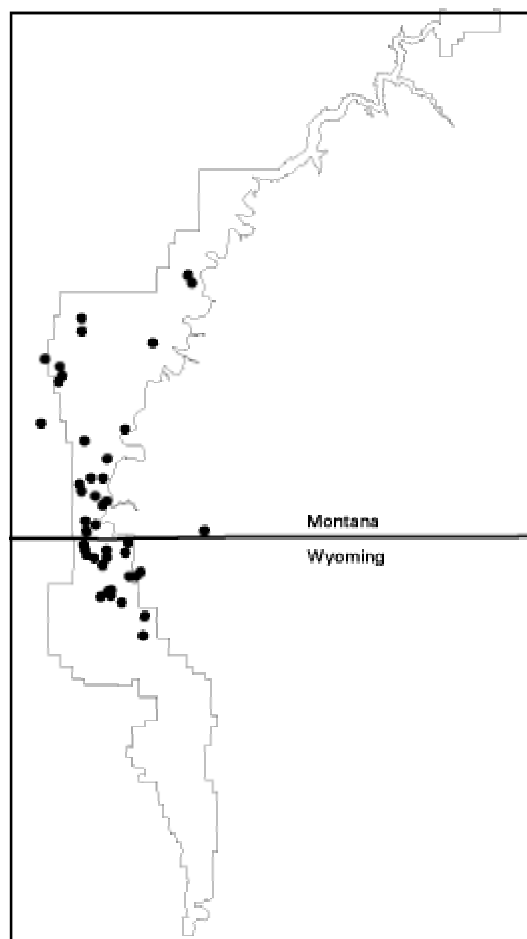


Figure 7. Distribution of *Erigeron allocotus* in Bighorn Canyon NRA



In the Bighorn Canyon, *Erigeron allocotus* forms three large population complexes on the east and west sides of Yellowtail Reservoir and the escarpment on the east flank of the Pryor Mountains. These three complexes converge in Montana and are more or less contiguous with populations in the east Pryor Mountains (Lesica and Achuff 1992). These contiguous population complexes might be a single metapopulation, very widely scattered over an area that is up to 15 miles long and 8 miles wide; the majority of the area lying within Bighorn Canyon NRA.

Habitat: Bighorn fleabane is found primarily on limestone and calcareous sandstone tablelands, rims, cliffs, and talus slopes. It is often part of cushion plant communities within sparse grasslands that lie within *Juniperus osteosperma* woodlands, *Cercocarpus ledifolius* scrub, or sagebrush (*Artemisia tridentata* or *A. nova*) steppe. It also grows in crevices of otherwise unvegetated outcrops. Bighorn fleabane is consistently found on the Madison, Amsden, and Tensleep formations, although large colonies have also been found on outcrops of the Chugwater Formation within sagebrush grasslands plains. Its exposed habitat is maintained in early stages of natural succession by the forces of wind and water. Populations range in elevation from 3680-7600 feet.

Figure 8. Mountain mahogany and escarpment habitats of *Erigeron allocotus*



Photo by Bonnie Heidel

In Bighorn Canyon NRA, Bighorn fleabane is commonly found in sparsely-vegetated cushion plant communities and outcrops on plateaus and rims of Tensleep Sandstone, Amsden sandstone and limestone, and Madison limestone (Figures 8 and 9). These

settings lie within a matrix of *Juniperus osteosperma* and *Cercocarpus ledifolius* woodlands, as well as on the barren rim and breaks above the canyon, and on the sparsely-vegetated escarpments marking the east flank of the Pryor Mountains. Plants are usually restricted to moisture-accumulating fissures in the bedrock covered by a thin layer of whitish rocky-sandy soil or sandstone and limestone gravel chips. Common associated species include *Haplopappus armerioides*, *Phlox hoodii*, *Gutierrezia sarothrae*, *Hedeoma drummondii*, *Leptodactylon caespitosum* (at the south end of the Canyon), and *Eriogonum pauciflorum*.

Figure 9. Canyon rim habitat of *Erigeron allocotus*



Photo by Bonnie Heidel

Bighorn fleabane also occurs in cushion plant communities on terrace rims of red clay covered with dolomite gravel. These sites are often dominated by *Hymenoxys acaulis*, *Arenaria hookeri*, *Phlox bryoides*, *Eriogonum brevicaulis* var. *canum*, and *Elymus spicatus*. On the east side of Yellowtail Reservoir, *E. allocotus* can also be found on steep upper slopes and rims of gravel and loose soil derived from the Goose Egg Formation. These sites may be locally dominated by *Artemisia nova*, *Phlox bryoides*, *Eriogonum pauciflorum*, *Elymus spicatus*, and occasional *Artemisia tridentata*. In all habitats, Bighorn fleabane is usually restricted to areas with less than 10% vegetative cover. Following the vegetation classification of Knight et al. (1987), *Erigeron allocotus* habitat falls into the Windswept Plateau, Juniper Woodland, and Mountain Mahogany Shrubland types.

Abundance

Population Size: In Montana, Bighorn fleabane is known from the Pryor Mountains/Bighorn Canyon area where it is widely distributed and uncommon to locally abundant (Lesica and Achuff 1992; and this study). There are currently 17 extant occurrences in Wyoming, consisting of at least 50 subpopulations, including two of the three vast Bighorn Canyon population complexes that span the state line and are the largest in the state. Wyoming populations range in size from fewer than 25 plants to over 20,000 individuals. There are currently 36 or more subpopulations in Montana. Total species numbers range wide total in the millions, although confined to a total area that is much less than the size of a typical county in either state, and occupying a very small fraction of the terrain across that area.

There are over 20 subpopulations of this species along the west and east sides of Yellowtail Reservoir in the Wyoming portion of the Bighorn Canyon NRA (WY element occurrences 010 and 023) numbering between 13,600-19,500 individuals. There are over 16 subpopulations of this species along the west side of Yellowtail Reservoir in Montana as far north as the northern end of the Pryor Mountains and one collection from the east side. Bighorn Canyon subpopulations are contiguous with 19 other Montana locations known for the species in Carbon County (MTNHP element occurrence records prior to 1992; and Lesica and Achuff 1992). The highest densities are in cushion plant communities and broken terrain adjoining them, but cushion plant communities are not as extensive as the species' cliff and escarpment habitat where widely-scattered plants are present over very large areas.

Trends: Most populations are thought to be stable under present management.

Management

Threats: Threats are low overall, and limited mostly to habitat disturbance (road construction, heavy trampling). While most of the habitat is in a state of early succession, it is not prone to destabilizing erosion. Grazing appears to be a low threat due to the plants' largely inaccessible habitat. It is possible that lower-elevation segments of populations were lost when Yellowtail Reservoir inundated the canyon, and a very small fraction of current Bighorn Canyon populations are near the highwater mark.

Protection Status: The Bighorn Canyon NRA encompasses three population complexes; two of which extend into Wyoming. The East Pryor Mountains ACEC population complexes are basically contiguous with Bighorn Canyon population complexes. Elsewhere, in Wyoming, one large occurrence is protected within The Nature Conservancy's Tensleep Preserve and five others are found within the Spanish Peak Karst and Little Mountain ACECs, and Shell Canyon Research Natural Area. One population is also found within a TNC conservation easement on the east slope of the Bighorn Range. Six occurrences are found in the potential Elephant Head, Tensleep Canyon, and Dry Fork Research Natural Areas and the Medicine Lodge and Trapper Peak Wilderness Study Areas. All other occurrences are on public lands managed for multiple use.

Land Ownership: The species occurs on lands managed by Bighorn National Forest, Bighorn Canyon National Recreation Area, and the BLM Billings, Cody, and Worland Field Offices.

Management Comments: Most individual colonies of Bighorn fleabane in Bighorn Canyon NRA are protected by their inaccessibility and require no special management attention, especially those on the east side of Yellowtail Reservoir in Wyoming, and on cliffs and escarpments in Montana. Impacts to populations in more accessible areas by surface-disturbing activities, such as trampling or camp ground and road development, are to be avoided.

Bighorn Canyon NRA Significance

Surveys by Lesica and Achuff (1992) and Heidel, Fertig, and Welp in 1998-99 have demonstrated that Bighorn fleabane is widespread and locally common within suitable habitats of the Bighorn Canyon NRA and adjoining Pryor Mountains. Bighorn Canyon NRA harbors 3 of the 11 protected populations for this species rangewide. They are the most extensive and part of the largest populations of this species throughout its entire range. The long-term survival of this species is conditioned by its status in the NRA. Bighorn fleabane is recommended for consideration by the National Park Service as a rare species, emphasizing conservation of its cushion plant community habitats.

***Eriogonum brevicaule* Nutt. var. *canum* (Stokes) Dorn Rabbit buckwheat Polygonaceae (Buckwheat Family)**

Synonym: *Eriogonum x lagopus* Rydb.

Status

Heritage Rank: Global – G3; Montana - S3 [watch; formerly listed as a species of special concern (Lesica and Shelly 1991) but downlisted to a watch species of limited distribution following the discovery of numerous large colonies in the Pryor Mountains by Lesica and Achuff (1992)]; Wyoming - S2 [Medium conservation priority]. May be removed from watch list in Montana based on this study.

Legal Status: USF&WS – former C2 (dropped as a candidate in 1996 with the elimination of the C2 program). BLM – None. USFS – None.

Description

Description: Rabbit buckwheat is a woody-based perennial with white-wooly stems 15-30 cm tall, surmounting a highly branched taproot (Figures 10,

Figure 10. Illustration of *Eriogonum brevicaule* var. *canum*

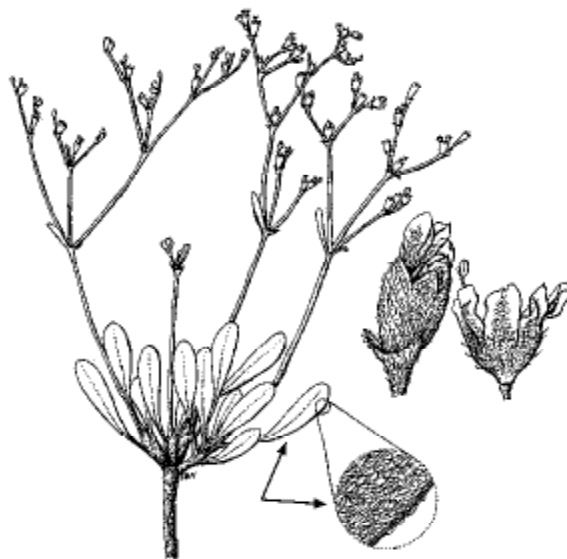


Illustration by Isobel Nichols
From "Wyoming Rare Plant Field Guide"

11). The leaves are linear-oblongate, densely white tomentose, and distinctly petioled. The yellow flowers are 1-2.5 mm long, hairy, lack a narrow, stipe-like base, and are arranged in an open, branched, woolly, umbel-like inflorescence (Clark and Dorn 1979, Fertig et al. 1994).

Figure 11. Photo of *Eriogonum brevicaule* var. *canum*



Photo by Bonnie Heidel

There has been much confusion in the literature regarding the taxonomy of this plant (Fertig 1999). It was originally described as a separate species (*Eriogonum lagopus*) by Rydberg in 1917 based on a Tweedy collection from the Dayton area in 1899 (Rydberg 1917) on the east slope of the Bighorns in Wyoming. Stokes (1936) created the name *E. multi-ceps* ssp. *canum* for Montana plants representing the same taxon. Reveal synonymized this name under *E. pauciflorum* var. *canum* in 1967, but later revived the name *E. lagopus* for the whole species (Reveal 1967, 1969). Reveal considered Rabbit buckwheat to be a fertile hybrid between *E. brevicaule* and *E. pauciflorum*. Dorn and others have studied the type specimen of *E. lagopus* and found that it does not cleanly represent the characteristic features of the taxon. Dorn proposed the name *E. brevicaule* var. *canum* to underscore its relationships with *E. brevicaule* (especially var. *micranthum*) (Clark and Dorn 1979, Dorn personal communication to Lesica 1992, Fertig 1999).

Similar Species: Other varieties of *Eriogonum brevicaule* differ in having glabrous stems and flowers or congested, head-like inflorescences. *E. pauciflorum* has pinkish-white flowers in a head-like inflorescence and matted stems. *E. flavum* has large, leaf-like bracts at the base of the umbel of flowers and

Figure 12. Montana and Wyoming county distribution of *Eriogonum brevicaule* var. *canum*

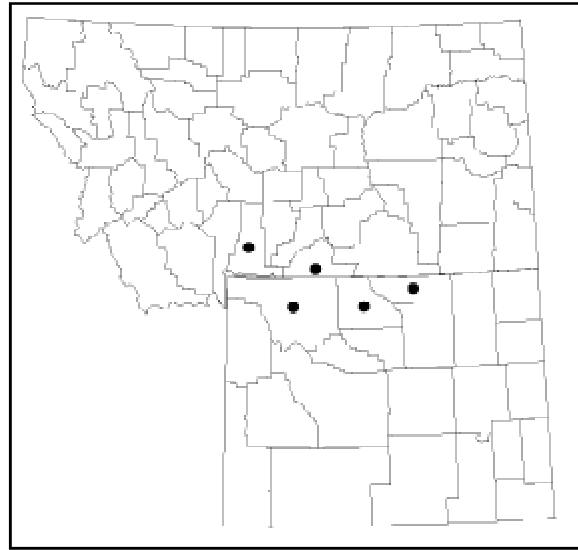
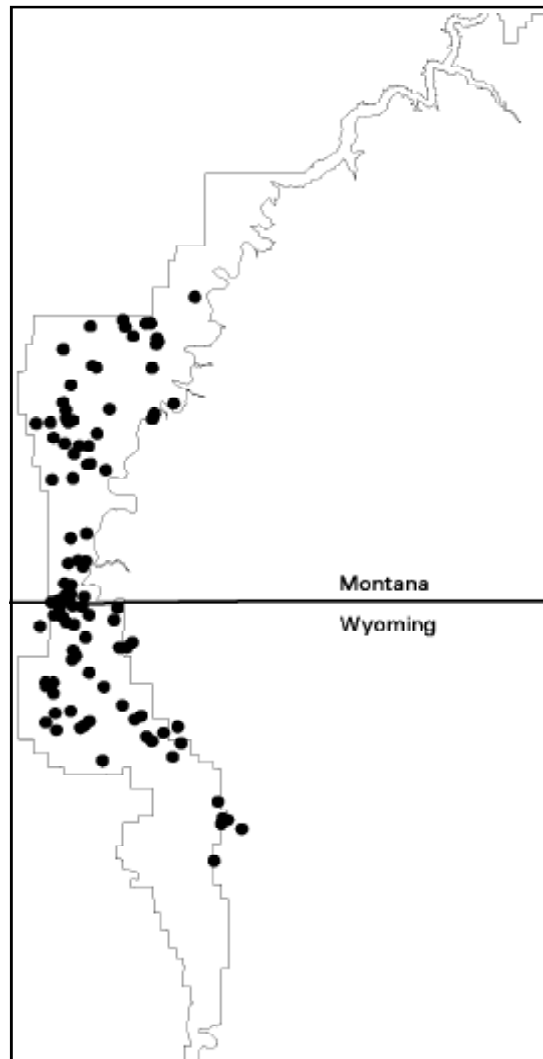


Figure 13. Distribution of *Eriogonum brevicaule* var. *canum* in Bighorn Canyon NRA



a stipe-like base above the true flowering pedicel. Vegetative specimens of *Senecio canus* have a more matted growth form.

Flowering/Fruiting Period: June-September.

Range and Habitat

Range: Rabbit buckwheat is a regional endemic of southern Montana and north-central Wyoming. In Wyoming, this species is known from the northern Bighorn Basin and east and west flanks of the Bighorn Range in Big Horn, Park, and Sheridan counties. Montana populations are centered in the Pryor Mountain desert region in Carbon County, where it was known from 45 sites. The species has also been reported from Treasure County and a historic collection near Livingston in Park Co. (MTNHP element occurrence records prior to 1992, and Lesica and Achuff 1992).

Habitat: Across its range, Rabbit buckwheat occurs commonly on barren to sparsely vegetated redbed clay or sandy soils in cushion plant, juniper woodland, and sagebrush steppe communities (Lesica and Achuff 1992; Fertig et al. 1994). It is also found on dolomite,

Figure 14. Chugwater Formation habitat of *Eriogonum brevicaule* var. *canum*



Photo by Laura Welp

sandstone, and siltstone outcrops and rims. Populations range in elevation from 3700-5500 feet. In Bighorn Canyon, *Eriogonum brevicaule* var. *canum* can be found on most upland shrub steppe and sparse grassland habitats at least as far north as Deadman Creek. It is abundant on Chugwater Formation redbed clay barrens dominated by scattered *Chrysothamnus nauseosus* var. *nauseosus*, *Artemisia tridentata* var.

wyomingensis, *Atriplex confertifolia*, or *Gutierrezia sarothrae* (total vegetative cover is usually 10-20%; Figure 14). Populations may also be locally abundant in cushion plant communities on terraces or gently dipping slopes of reddish clay and dolomite pebbles derived from the Goose Egg Formation. Common

Figure 15. Limestone habitat of *Eriogonum brevicaule* var. *canum*



Photo by Laura Welp

associated species at these sites include *Haplopappus nuttallii*, *Arenaria hookeri*, *Hymenoxys acaulis*, *Astragalus hyalinus*, and *Elymus spicatus*. In some areas, *E. brevicaule* var. *canum* itself may be one of the dominant forbs, and “*Chrysothamnus nauseosus*/*Eriogonum brevicaule* var. *canum* p. a.” was provisionally identified as a distinct plant association in the Pryor Mountains (DeVice and Lesica 1993). Rabbit buckwheat is present, but less abundant, in *Cercocarpus ledifolius* woodlands and openings within *Juniperus osteosperma* woodlands on outcrops of Tensleep Sandstone, Madison Limestone, and dolomite covered by small gravel (Figure 15). These sites may be locally dominated by low shrubs, cushion plants, or sparse grasslands with total vegetative cover under 20%. It is consistently found in well-developed cushion plant communities, often in low numbers,

where it is associated with *Hymenoxys acaulis*, *Arenaria hookeri*, *Phlox bryoides*, *Erigeron allocotus*, *Townsendia spathulata* and *Elymus spicatus*. It is occasional or rare in *Artemisia nova* communities and grassland communities where it is associated with *Senecio canus*, *Artemisia frigida*, *Elymus spicatus*, *Bouteloua gracilis*, and *Linum lewisii*. Knight et al. (1987) reported “*Eriogonum brevicaulle*” (presumably var. *canum*, following Lichvar et al. 1985) from the Mixed Desert Shrubland, Windswept Plateau, Basin Grassland, Sagebrush Desert Shrubland, Sagebrush Steppe, Juniper Woodland, and Mountain Mahogany Shrubland vegetation types.

Abundance

Population Size: Although they vary in size, most individual populations of Rabbit buckwheat are abundant or even locally dominant (DeVelice and Lesica 1993). Prior to 1998, this species was known from only six extant and one historical population in Wyoming, all of which were thought to be small. Surveys in the Wyoming portion of Bighorn Canyon NRA in 1998-99 resulted in the discovery of nearly 50 subpopulations numbering over 200,000 individuals. Lesica and Achuff (1992) reported 40 large populations in the Pryor Mountain desert area in 1992 and over 50 subpopulations have been reported in the Montana portion of the Bighorn Canyon NRA.

Trends: Although no long-term monitoring studies have been conducted, this species is presumed to be stable at present.

Management

Threats: Individual plants or small subpopulations may be threatened by recreational activities and road construction. There is little evidence that this species is regularly grazed by livestock or wild horses, though it is palatable. It appears to be present in similar numbers on both sides of fencelines that separated grazed from ungrazed conditions within the study area.

Protection Status: Two extensive Wyoming population complexes are protected within Bighorn Canyon National Recreation Area, two of which extend into the BLM Little Mountain Area of Critical Environmental Concern and the BLM East Pryor Mountain Area of Critical Environmental Concern. Other populations are on federal or state public lands managed for multiple use.

Land Ownership: Occurs in Bighorn Canyon National Recreation Area and lands managed by the BLM Billings and Cody Field Offices.

Management Comments: *Eriogonum brevicaulle* var. *canum* is locally abundant in a number of vegetation types that cover large areas of the landscape, and has few threats. No special management is required to ensure the survival of this species. It is sometimes concentrated in or adjoining cushion plant communities, which may warrant more detailed documentation as habitats of special management concern.

Bighorn Canyon NRA Significance

Bighorn Canyon NRA supports the largest known populations of Rabbit buckwheat in Wyoming, conservatively estimated at over 200,000 plants, as well as extensive contiguous populations on the Montana side. Rabbit buckwheat is not considered a species of special concern in Montana and in light of discoveries at Bighorn Canyon, it will probably be downlisted to WYNDD’s “watch list” in the near future. This species is not recommended for consideration by the National Park Service as a rare species.

***Lesquerella lesicii* Rollins**

Lesica’s bladderpod

Brassicaceae or Cruciferae (Mustard Family)

Status

Heritage Rank: Global Rank - G1; Montana - S1; Wyoming - not present

Legal Status: USF&WS Status - None, BLM Status (MT) - Sensitive. USFS Status - None.

Description

Description: Lesica’s bladderpod is a short-lived perennial with few, unbranched, prostrate to ascending stems that arise from an unbranched rootcrown and taproot (Figure 16). The basal leaves have petioles that are 1-3 cm long and spade-shaped blades that are shorter than the petiole with entire margins. The alternate stem leaves are much smaller, broadly lance-shaped, and without petioles. Foliage is sparsely covered with sessile, star-shaped hairs. Yellow, stalked flowers are borne at the tops of the stems in a narrow inflorescence that elongates as the fruit matures. Each

Figure 16. Photo of *Lesquerella lesicii*



Photo by Peter Lesica

flower has 4 separate petals, 4 separate sepals, and 4 long and 2 short stamens. The globose siliques have a short style on top and are borne on reflexed stalks. It was first collected by Peter Lesica in 1991, and only recently described by Reed Rollins (1995).

Similar Species: The globose, unlobed siliques borne on reflexed stalks when mature separate this plant from other species of *Lesquerella* in our area, except for *L. ludoviciana*, which has narrowly elliptic to lance-shaped leaf blades. It is most closely related to *Lesquerella fremontii*, a state endemic of Wyoming, from which it differs in having basal leaves with very thin petioles that expand abruptly to the blade, and fruiting pedicels that are thread-like and fragile (Lesica 1995). It superficially resembles lax forms of the widespread *Lesquerella alpina*.

Flowering/Fruiting Period: Flowering in mid-late June; fruits needed for positive identification.

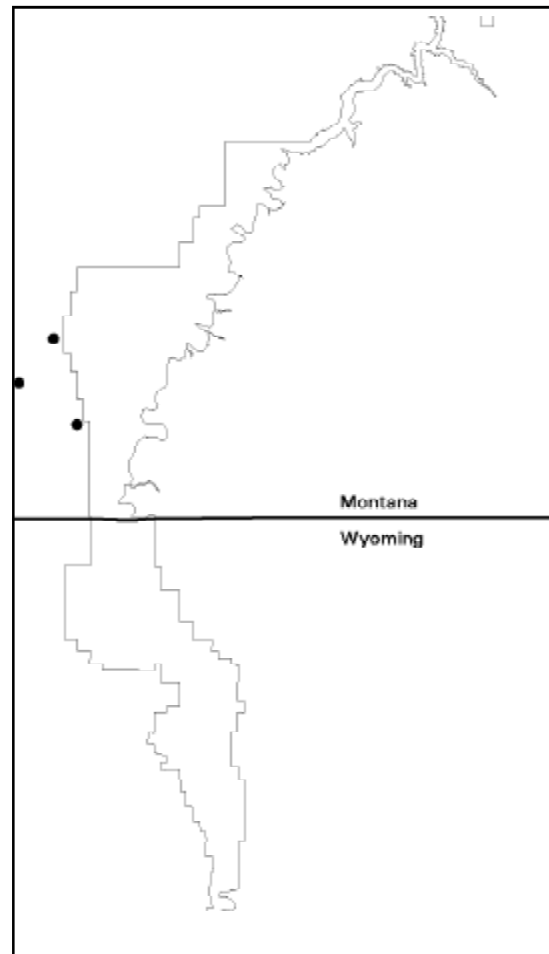
Range and Habitat

Range: Lesica's bladderpod is a state endemic known only from the Pryor Mountains of Carbon County, Montana. It has been documented from a total of three separate areas in the East Pryor Mountains, including two segments of Sykes Ridge, which

Figure 17. Montana and Wyoming county distribution of *Lesquerella lesicii*



Figure 18. Distribution of *Lesquerella lesicii* in Bighorn Canyon NRA



overlooks Bighorn Canyon NRA and represents the easternmost ridge in the Pryor Mountains. It has been surveyed over large areas of the Pryor Mountains on BLM and USFS land, but has not been surveyed on similar habitat in the Big Horn Mountains of the Crow Indian Reservation, or adjacent Big Horn National Forest of Big Horn and Sheridan counties, Wyoming. Outliers of the Sykes Ridge populations are found in Bighorn Canyon NRA scattered on rocky slopes near the head of Layout Creek and across the escarpment face. This is perhaps the most geographically restricted of globally rare species in the Bighorn Canyon study area, and the center of its known distribution is directly adjoining but outside of the study area.

Habitat: It is restricted to gravelly, limestone-derived soil of open ridges and slopes surrounded by woodlands of *Pinus flexilis*, *Pseudotsuga menziesii* and *Cercocarpus ledifolius* in the montane zone at 5300-7600 ft. Soils are derived from Madison limestone with a high proportion of coarse fragments. It occurs in two sparsely-vegetated plant associations with 50-80% of the soil surface barren (Lesica 1995). In the Bluebunch Wheatgrass – cushion plant fellfields it grows with *Draba oligosperma*, *Elymus spicatus*, *Eritrichium howardii*, *Lomatium cous*, *Haplopappus acaulis*, *Hymenoxys torreyana*, *Phlox hoodii*, and *Potentilla ovina*. In the *Juniperus scopulorum* – *Cercocarpus ledifolius* communities, it grows with *Juniperus osteosperma* (replacing *J. scopulorum* at lower elevations), *Artemisia nova*, *Artemisia tridentata*, *Symphoricarpos oreophilus*, *Carex rossii*, *Cerastium arvense*, *Haplopappus acaulis*, *Koeleria macrantha*, *Lesquerella alpina*, and *Musineon vaginatum*.

Figure 19. Escarpment habitat of *Lesquerella lesicii*



Photo by Bonnie Heidel

In Bighorn Canyon, it occurs on generally steep, rocky slopes of Bluebunch Wheatgrass – cushion plant community that are generally inclusions across the slope face among scree, or areas dominated by *Cercocarpus ledifolius* and *Pseudotsuga menziesii* (Figure 19).

Abundance

Population size: Lesica's bladderpod is known from three occurrences with estimated population numbers ranging from 1,000 – 100,000 individuals. It is often uncommon or occasional where it is found, but there are areas of notably high density on Sykes Ridge, where there is the largest population. It is most common on ridgetop settings, and sparser on ridge slopes. Two of the three occurrences have minor extensions into Bighorn Canyon NRA. The slopes above Layout Creek have 100+ plants as fringes or outliers of the main ridgetop population. The semi-sheltered nature of the area may be most conducive to this species of available Bighorn Canyon habitat. The East Pryor Mountains escarpment elsewhere has very low numbers that may be outliers from the nearest ridgetop populations.

Trends: This species has a delicate stature and unbranched caudex, suggesting that it is a short-lived perennial (Lesica 1995). As such, climate-induced population fluctuations are likely. The species has not been monitored to determine trends or demography.

Management

Threats: There may have been direct impacts to the species in the trailing and terracing through its habitat, most likely the results of horses foraging for grass, and the extent of trampling and terracing by wild horses in species' habitat may warrant monitoring on BLM land (Lesica 1995). The steep, remote sites on Bighorn Canyon NRA are not affected by trailing.

Considering the frail growth form and the harsh environment, it is likely to both benefit by and compete with surrounding vegetation, depending on the yearly climates. This phenomenon has been documented for other rare members of the genus and has the effect of buffering climate extremes (Greenlee and Callaway 1996). The vegetation characteristics of its habitat are not readily affected by management actions or policy, except as potential large-scale changes to the landscape, like fire and disease, are involved.

Protection Status: It is designated as a BLM sensitive species in Montana.

Land Ownership: All known occurrences of this species are on BLM-administered lands, with the exception of the population outliers extending into Bighorn Canyon NRA.

Management Comments: There are no immediate management needs for Lesica's bladderpod on Bighorn Canyon NRA, but management of horses and their traffic from the study area to the adjoining Wild Horse Management Range potentially affects the species. Species' establishment requirements and the affects of terracing warrant documentation on adjoining BLM lands.

This species occupies sparsely-vegetated habitat on otherwise forested ridges. Its response to fire is not known.

Bighorn Canyon NRA Significance

Lesica's bladderpod is the most globally rare of the species known from Bighorn Canyon NRA. It barely enters the area in having scattered plants in low numbers, representing population outliers. Considering that it is a narrow endemic, the intact environmental gradient represented by the east face of the Pryor Mountains escarpment is important buffer to the species. Management recommendations regarding wild horse trampling and terracing (Lesica 1995) pertain to the species' ridgetop habitat on adjoining BLM lands. This is among the highest species priorities for coordination with BLM in management affecting Sykes Ridge among the species shared in common with adjoining BLM lands.

***Rorippa calycina* (Engelm.) Rydb.** Persistent-sepal yellowcress Brassicaceae or Cruciferae (Mustard Family)

Status

Heritage Rank: Global – G3; Montana - S1; Wyoming - S2S3 [Medium conservation priority]; North Dakota - SH.

Legal Status: USF&WS – former C2 (dropped as a candidate in 1996 with the elimination of the C2 program). BLM – None. USFS – None.

Description

Description: Persistent-sepal yellowcress is a rhizomatous perennial herb with upright or spreading stems 10-40 cm tall (Figures 20, 21). The stems and foliage are pubescent throughout with stiff, unbranched hairs.

Figure 20. Illustration of *Rorippa calycina*

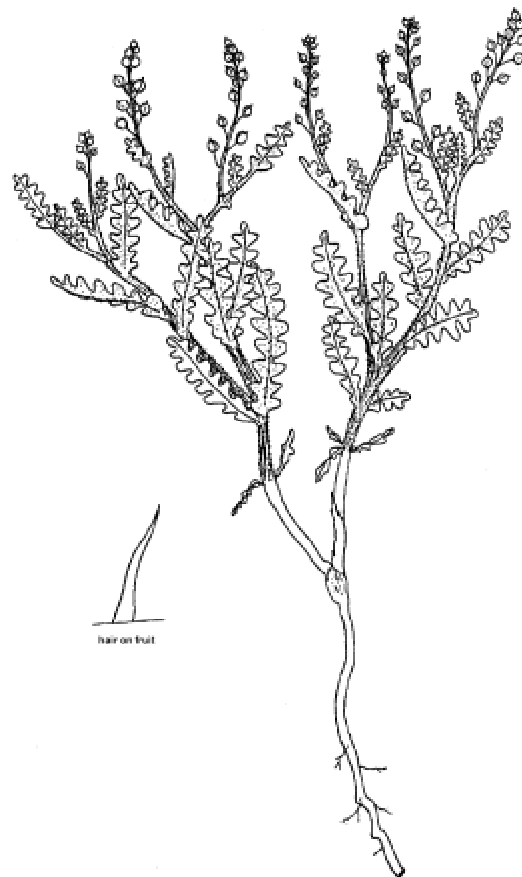


Illustration by Jane Dorn
From "Wyoming Rare Plant Guide"

Stem leaves are pinnately divided or wavy-lobed, sessile, and 2.5-5 cm long. The flowers are borne in terminal and axillary inflorescences and have 4 yellow petals 3-5 mm long and 4 sepals that persist in fruit. Fruits are ovoid to nearly globose, 2-4 mm long, and conspicuously pubescent with unbranched hairs that are broadest at the base. Styles in fruit are 1-2 mm long and glabrous (Stuckey 1972; Hitchcock et al. 1964; Clark and Dorn 1979; Dorn 1992; Rollins 1993; Fertig et al. 1994; Fertig and Welp 1998).

Similar Species: *Rorippa sinuata* has elongate, glabrous fruits over 5 mm long, deciduous sepals, and round, glassy, ball-like hairs on the leaves. *R. curvipes* often has white petals, finely hairy sepals, deeply pinnate leaves and glabrous to sparsely hairy fruits and leaves. All other Montana and Wyoming species of *Rorippa* are taprooted annuals or biennials with longer, more erect stems and fruits that are either round or narrowly elongate. Seedlings of *Ambrosia tomentosa* have wider leaves with whitish undersides. Seedlings of annual *Potentilla* species have 3-5 round-lobed leaflets (Fertig and Welp 1998).

Figure 21. Photo of *Rorippa calycina*



Photo by Jennifer Whipple

Flowering/Fruiting Period: Flowers from late May to August, although blooming may extend into October under favorable circumstances. May also reproduce asexually by rhizomes.

Range and Habitat

Range: Persistent-sepal yellowcress is a regional endemic of eastern Montana, adjoining North Dakota, and central Wyoming. Its seeds are carried by water-fowl and there is record of a disjunct population 2,500 miles to the north on the Arctic coast of Canada's

Figure 22. Montana and Wyoming county distribution of *Rorippa calycina*

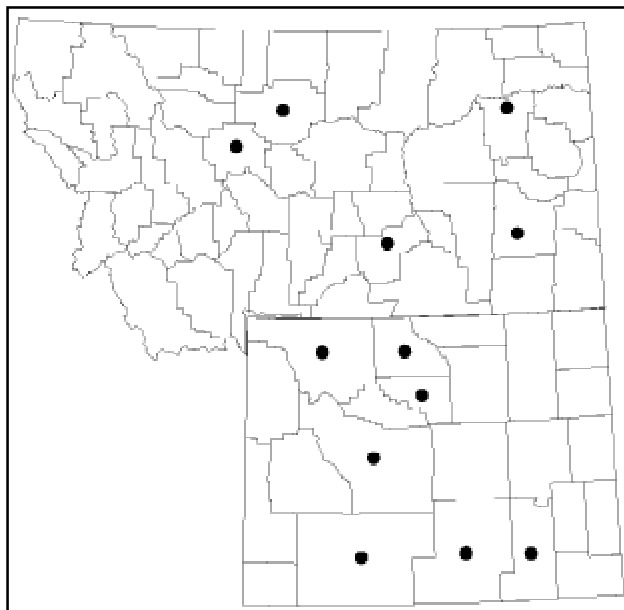
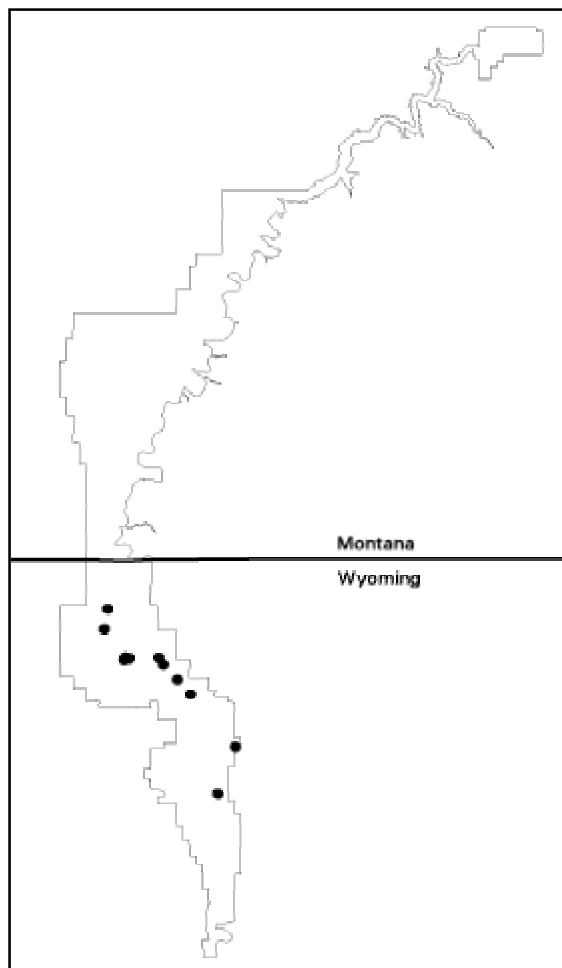


Figure 23. Distribution of *Rorippa calycina* in Bighorn Canyon NRA



Northwest Territories (Mulligan and Porsild 1966). In Wyoming, it is known from the Bighorn Basin, North Platte River drainage, and Great Divide, Green River, and Wind River basins in Albany, Big Horn, Carbon, Fremont, Park, Sweetwater, and Washakie counties (Fertig and Welp 1998). In Montana, it was known from the Missouri and Yellowstone River drainages, including historic records from Cascade, Custer and Yellowstone counties, and two recent records from Choteau and McCone counties that are likely to be extirpated (Heidel 1994). In North Dakota, it was historically known from McKenzie County at the mouth of the Yellowstone River.

Habitat: This species is found primarily along moist sandy to muddy banks of streams, stock ponds, and man-made reservoirs near the high-water line. The typical shoreline zone is a broad flat and includes sandy parent material. Early collections suggest that its natural habitat was confined to zones below the highwater mark of Great Plains rivers. It is considered a facultative wetland species (USDI Fish and Wildlife Service 1993). Most populations are in sparsely-vegetated settings that are semi-disturbed or recently flooded openings in small inlets or bays with scattered **clumps of** *Hordeum jubatum*, *Poa secunda*, *Elymus smithii* and a variety of native or exotic early successional forbs. Occasionally, plants can also be found on grassy shores or in openings amid *Salix exigua* or *Tamarix chinensis* thickets. One atypical population in Wyoming is found along a sandy roadcut, several miles from the nearest shore. Total vegetative cover at all sites averages 5-10%. The species ranges in elevation from 3660-6800 ft. (Fertig and Welp 1998).

Figure 24. Inlet habitat of *Rorippa calycina*; note Saltcedar



Photo by Walter Fertig

Figure 25. Shoreline habitat of *Rorippa calycina*



Photo by Walter Fertig

At Bighorn Canyon, it occurs on moist, reddish sandy-clay soils lining small inlets along the shore of Yellowstone Reservoir (Figures 24, 25). These sites are often dominated by Saltcedar and other weedy species, including *Salsola australis*, *Sisymbrium altissimum*, *Cirsium arvense*, and *Verbena bracteata*. The inlets are at least seasonally flooded, and may remain inundated during the summer during high water years as in 1999. Soils in these inlets are derived from the Goose Egg, Amsden, and Chugwater formations and Quaternary gravels. The habitat of *R. calycina* falls into the Floodplain meadows and mudflats vegetation type of Knight et al. (1987).

Abundance

Population Size: Persistent-sepal yellowcress is currently known from 23 occurrences in Wyoming, all of which have been discovered or relocated since 1977. These occurrences consist of at least 70 subpopulations covering a total area of ca. 110 acres. Individual colonies typically contain 10-300 plants in an area of 0.1-5 acres. Fertig and Welp (1998) conservatively estimated the total state population at 15,000-25,000 plants based on surveys of 27 subpopulations in 1997. By contrast, there are no known extant populations in Montana or North Dakota.

Trends: In Wyoming, *Rorippa calycina* has probably been increasing over the past half century due to its ability to colonize shores of artificial reservoirs. Rollins (1993) noted "it appears that the provision of suitable habitats by the construction of reservoirs has provided for an unusual increase in the number of populations of this species." Fertig and Welp (1998) found the total Wyoming population to be essentially stable between 1997 and 1981 (Lichvar 1981). Long-

term trend data, however, are not available for most populations. Individual colonies appear to vary in size and area from year to year in response to flooding levels. For example, Heidel observed plants at the Crooked Creek colony in June 1999, but no plants remained after it had been inundated by high water later in the summer. Other populations in Wyoming have been periodically flooded, only to return during periods of low water, possibly from a remnant seedbank on site or in the near vicinity (Fertig and Welp 1998). In Montana, the paucity of recent records and extirpation of two small populations suggests that the species may be declining, though there has been little survey work.

Management

Threats: Changes in watershed management could have important impacts on reservoir populations of *Rorippa calycina* in Wyoming. Fluctuating water levels are critical for creating and maintaining the shoreline flats habitat favored by this plant. Maintaining reservoirs at a constant level could encourage later successional species to become established and crowd out this species. Permanently raising water levels could wipe out existing, low-lying colonies, but should create new habitat higher on the bank. Colonization of such sites, however, could be restricted if existing seedbanks are eliminated (Fertig and Welp 1998).

Competition from exotic plants, especially Saltcedar, is a serious threat at several reservoir sites, including Yellowtail Reservoir on Bighorn Canyon NRA. Dense growth of Saltcedar can shade out *Rorippa* and stabilize its shoreline habitats (Fertig and Welp 1998). Spotted knapweed is present at a number of Bighorn Canyon NRA public access sites and could become a serious threat through competition for habitat. Weed control efforts need to be planned carefully to ensure that herbicides do not directly kill *R. calycina* plants or negatively affect its pollinators. Other potential threats include soil compaction from off-road vehicles in shoreline habitats, development of shoreline recreational facilities or access, trampling of plants and their habitat from high concentrations of livestock and wildlife, and impacts from pollution associated with mining (Fertig and Welp 1998).

Protection Status: Four populations of *Rorippa calycina* are found on lands that receive some formal protection, including Bighorn Canyon NRA, the

Wyoming Nature Conservancy's Red Canyon Ranch, Pathfinder National Wildlife Refuge, and the BLM Red Canyon ACEC (managed by the Rawlins Field Office). Seven populations are also found on Wyoming state park lands (Boysen, Buffalo Bill, and Seminoe), but these sites are managed mainly for recreation rather than natural values. A collection in Montana came from private lands within the Wild and Scenic Missouri River corridor and the population may or may not be extant. All other extant populations are on public or private lands managed for multiple use.

Land Ownership: *Rorippa calycina* occurs in Wyoming on lands managed by Ashley National Forest (Flaming Gorge National Recreation Area), National Park Service (Bighorn Canyon National Recreation Area), U.S. Fish and Wildlife Service (Pathfinder National Wildlife Refuge), and the BLM Cody, Lander, Rawlins, and Worland Field Offices. The species is also present on Wyoming state park lands at Boysen, Buffalo Bill, and Seminoe Reservoirs, and on private lands.

Management Comments: Management of water levels is important for the maintenance of the shoreline habitat of *Rorippa calycina*, especially in reservoir settings that make up most of its known habitat. Current management practices and unpredictable annual precipitation rates are probably adequate to ensure fluctuating water levels in Yellowtail Reservoir. Impacts from invasive plants, especially Saltcedar, need to be carefully monitored. A control program for Saltcedar should be implemented in selected drainages to test possible effects on *R. calycina* populations. Control programs should focus on methods that are non-injurious to desirable native species and pollinators. Known colonies of *R. calycina* should be revisited periodically to ensure that populations are maintaining themselves, and additional areas of potential habitat should be investigated for new colonies. A monitoring program should be initiated at selected sites to assess overall population trends beyond the natural population fluctuations that occur due to alternating flooding/drying cycles.

Bighorn Canyon NRA Significance

Persistent-sepal yellowcress was first documented at one site near the Horseshoe Bend marina in Bighorn Canyon NRA by Robert Lichvar in 1983 (Lichvar et al. 1985). In 1998, 10 additional colonies were

discovered by Fertig along the east and west banks of Yellowtail Reservoir, extending from the Crooked Creek inlet south to the US Highway Alt 14 causeway. Much additional habitat probably exists in the NRA, especially in small inlets along the east shore of the reservoir. It was not found on the Montana side, but the survey was conducted under high water conditions. In the canyon, shoreline habitat is subject to flooding and confined to narrow bands. No habitat was observed on the west shore south of the causeway in 1998. Some potential habitat investigated by Welp in 1999 was flooded by high water and contained no plants. Fertig estimated the total population in Bighorn Canyon at approximately 7500 plants in 10-15 acres of habitat in 1998.

The Bighorn Canyon NRA population is one of only four occurrences rangewide found on lands managed specifically for natural values or wildlife. Colonies on the east bank of Yellowtail Reservoir (with the exception of the subpopulation near the US Highway Alt 14 causeway) are in isolated areas that receive minimal direct human impacts. Although these colonies are small and threatened by Saltcedar, they are the best-protected sites currently known for the species throughout its range. The long-term survival of this species may be strongly influenced by management actions in the NRA. Thus, it is recommended for consideration by the National Park Service as a rare species, emphasizing Saltcedar control and concerted water level management.

Stanleya tomentosa* Parry var. *tomentosa

Hairy prince's-plume
Brassicaceae (Mustard Family)

Status

Heritage Rank: Global – G4T3; Montana – S3 [watch; formerly listed as a species of special concern (Lesica and Shelly 1991) but downlisted to a watch species of limited distribution following the discovery of numerous small colonies in the Pryor Mountains by Lesica and Achuff (1992)]; Wyoming – S2. [Medium conservation priority] May be more abundant in Wyoming than currently recognized. Rank may be revised to S3 in the near future.

Legal Status: USF&WS – None. BLM - None. USFS – None.

Description

Description: Hairy prince's-plume is a perennial forb with an unbranched caudex covered by persistent leaf bases. Stems are erect, single or branched above, 5-15 dm tall, leafy, and densely pubescent with short, tangled, woolly hairs (Figures 26, 27). Basal leaves are 1-3 dm long, 2-6 cm wide, long-petioled, and have broadly lance-shaped, runcinate-pinnatifid blades (dissected like a dandelion leaf) covered with felt-like pubescence. Stem leaves are similar to the basal leaves, but become gradually smaller and entire or arrowhead-shaped farther up the stem. The elongate, densely-congested inflorescence is 2-6 dm long and has hirsute branches. Flowers consist of 4 pale yellowish-green, pubescent, sepals and 4 glabrous, lemon yellow petals that are wider at the base than the tip. Fruits are slender, erect, glabrous, distinctly com-

Figure 26. Illustration of *Stanleya tomentosa* var. *tomentosa*

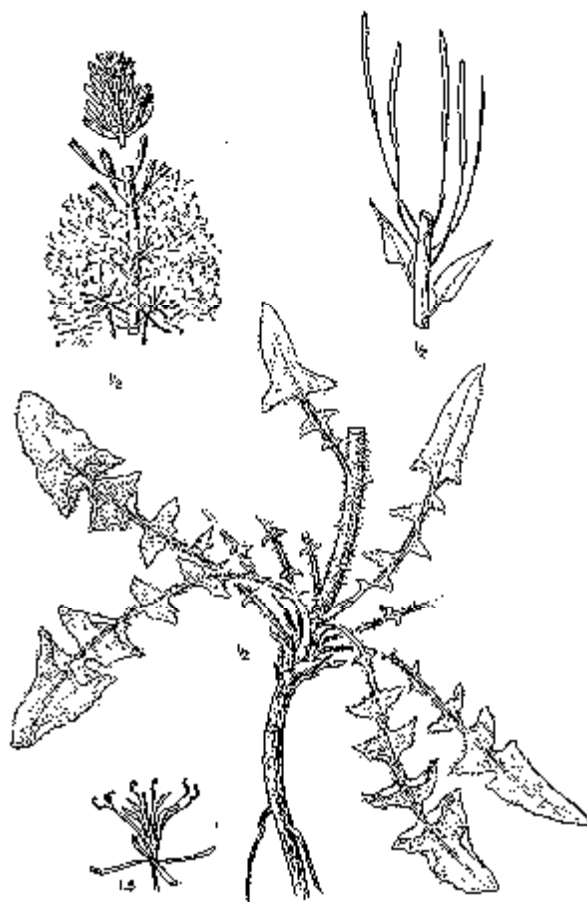


Illustration by Jeanne R. Janish
From "Vascular Plants of the Pacific Northwest"

Figure 27. Photo of *Stanleya tomentosa* var. *tomentosa*



Photo by Walter Fertig

pressed siliques 4-7 cm long and about 2 mm wide. The base of the fruit narrows to a slender stalk-like structure (gynophore) borne above the true fruit stalk (pedicel). Seeds are brown, oblong, and lack wings (Rollins 1939, 1993; Hitchcock and Cronquist 1964; Dorn 1992).

Similar Species: *Stanleya viridiflora* has sessile stem leaves and glabrous stems. *S. pinnata* has glabrous or sparsely short-hairy leaves and stems and pubescent petals.

Flowering/Fruiting Period: June-July. Note: Mature plants do not produce flowers every year, sometimes remaining as basal rosettes.

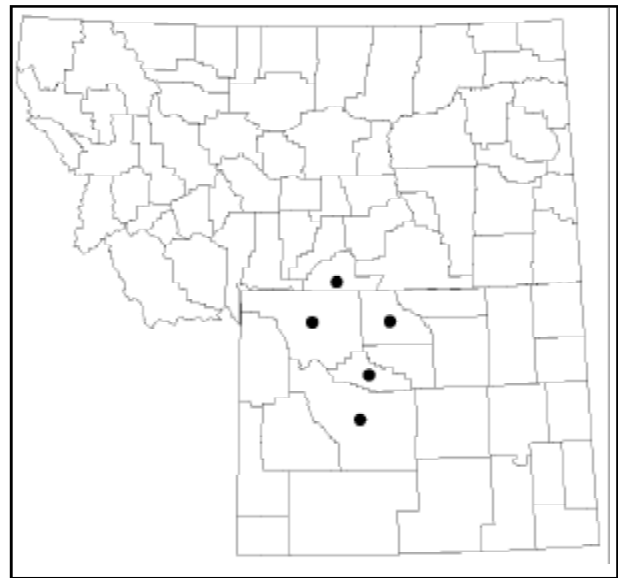
Range and Habitat

Range: Hairy prince's-plume is a regional endemic of south-central Montana and north-central Wyoming. Populations in Montana are restricted to the Pryor Mountain area in Carbon County. In Wyoming, this species is found in the Big Horn Basin and foothills of the Absaroka, Big Horn, Bridger, and Owl Creek

mountains in Big Horn, Fremont, Hot Springs, and Park counties.

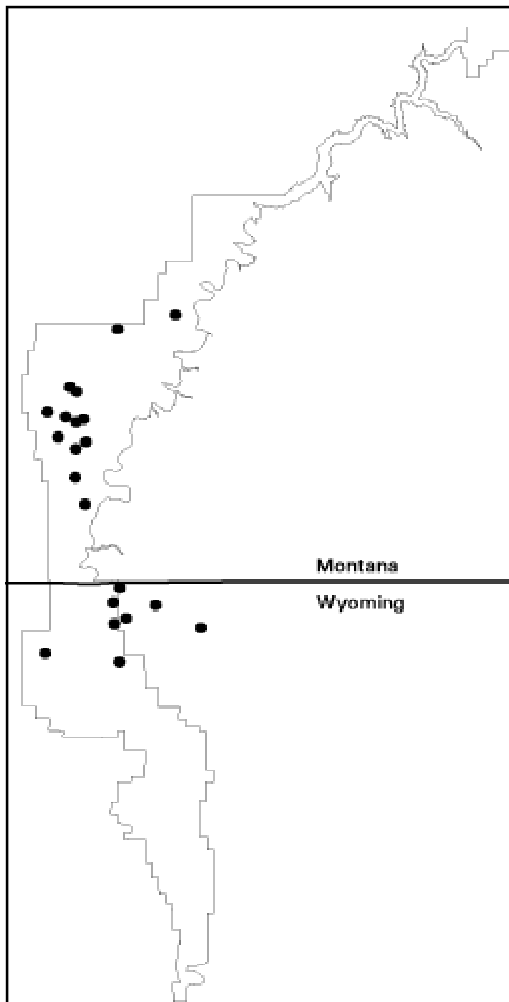
Habitat: Hairy prince's-plume occurs primarily in cushion plant communities, Black sagebrush-grasslands, Limber pine woodlands, and Utah juniper woodlands on limey-sandstone ridges, dry dolomite cliffs and talus, sandy canyons, or rocky clay slopes in the foothills of desert mountains (Lesica and Achuff 1992, Fertig and Jones 1997). Populations range in elevation from 3800-7300 feet.

Figure 28. Montana and Wyoming county distribution of *Stanleya tomentosa* var. *tomentosa*



In the Wyoming portion of Bighorn Canyon NRA, Hairy prince's-plume is found mostly on slopes of fissured, white, limey-sandstone boulders and bedrock outcrops of Tensleep Sandstone in openings within *Pinus flexilis*/*Juniperus* woodlands. The understory of these sites is usually dominated by cushion plants and bunchgrasses that provide a total cover of at least 50%. Common associated species include *Erigeron allocotus*, *Lesquerella alpina*, and *Stipa comata*. Populations of *S. tomentosa* can also be found in cushion plant communities dominated by *Phlox bryoides*, *Haplopappus armerioides*, *Paronychia sessiliflora*, and *Penstemon laricifolius* on slopes and low knolls of rocky-sandy calcareous soils with vegetative cover under 40%. Knight et al. (1987) describe this species from the Basin Grassland and Windswept Plateau vegetation types.

Figure 29. Distribution of *Stanleya tomentosa* var. *tomentosa* in Bighorn Canyon NRA



In the Montana portion of Bighorn Canyon NRA, Hairy prince's-plume is most often found on Juniper Woodland ridges on the Chugwater Formation. Common associated species making up the sparse vegetation include *Elymus spicatus*, *Phlox bryoides*, and *Hymenoxys acaulis* (Figure 20). It is also found on Great Basin grasslands that are at lower slope positions and toeslopes of the East Pryor Mountains and on isolated Quaternary gravel terraces. Common associated species include *Elymus spicatus*, *Bouteloua gracilis*, *Phlox hoodii*, and *Gutierrezia sarothrae*.

Abundance

Population Size: Rangewide, Hairy prince's-plume is known from approximately 50 localities. Lesica and Achuff (1992) documented 28 populations in the Pryor Mountains of Montana, most of which were "sparse but widespread". It was previously documented from Bridger and Bluewater Creek north of

the Pryor Mountains. In Wyoming, this taxon is currently known from 17 extant occurrences. Most populations have fewer than 50 individuals in an area of less than 3 acres.

Figure 30. Ridge habitat of *Stanleya tomentosa* var. *tomentosa*



Photo by Bonnie Heidel

Trends: Long-term trend data are not available for this species. Some populations in Wyoming may be declining due to habitat loss or herbivory.

Management

Threats: Hairy prince's-plume may be threatened by surface disturbances associated with mineral development at some sites in Wyoming. Overall, most of the habitat of this species is rugged enough that such threats are moderate. This species is readily grazed and browsed by stock and big game, but the impacts from herbivory are not fully known. Heidel observed that flowering stems had been eaten on a wild horse pasture of Bighorn Canyon NRA. It was also noted on both sides of a fenceline separating grazed from ungrazed areas of the study area, in lower numbers with no flowering stalks on the grazed side (Heidel pers. obs.) The species attracts a diverse insect fauna to its flowers, and its dependence on specific pollination vectors is not known.

Protection Status: Montana occurrences are found in Bighorn Canyon NRA and several more populations are protected on the adjoining East Pryor Mountains Area of Critical Environmental Concern. Two Wyoming occurrences are found in Bighorn Canyon NRA, one extending into the BLM Little Mountain Area of Critical Environmental Concern. An additional Wyoming population is found just outside the Shell Canyon Research Natural Area and potential Elephant

Head RNA on Bighorn National Forest. All other occurrences in Wyoming are on public, state, or private lands managed for multiple use.

Land Ownership: Populations occur on lands managed by Bighorn National Forest, Bighorn Canyon NRA, the BLM Billings, Cody, Lander, and Worland Field Offices, Montana Department of Fish, Wildlife & Parks lands (Bluewater Fish Hatchery), and private lands.

Management Comments: Additional information is needed on the population dynamics of this species and its response to herbivory. The small size of most subpopulations makes them potentially vulnerable to large-scale habitat disturbance, high grazing pressure, the loss of pollinators, and chance environmental mishaps. It should be surveyed in all Bighorn Canyon NRA exclosures, and the fenceline contrast beside the Park road evaluated more completely. Pending review of these results, it may be appropriate to develop a demographic monitoring program to shed light on natural population fluctuations and on basic natural history of this plant. Additional information on species' response to fire may also warrant evaluation in any prescribed burn management actions.

Bighorn Canyon NRA Significance

At least 8 subpopulations of Hairy prince's-plume are found in Bighorn Canyon NRA and adjacent BLM lands on the east side of Yellowtail Reservoir in Wyoming, and over 10 subpopulations are scattered on the west side of Yellowtail Reservoir in Montana. In 1999 these subpopulations contained over 300 individuals in a total area of 20 acres (Wyoming), and over 60 individuals in a total area of less than 20 acres (Montana). Although small, most of these colonies are secure and have low threats. A second population on the west side of the reservoir in Wyoming discovered in 1983 could not be relocated in 1998 or 1999 and may be extirpated. Bighorn Canyon NRA is one of the few locations in Montana or Wyoming where Hairy Prince's-plume is afforded any protection, and maintenance of healthy populations in the NRA is important from a rangewide perspective.

Sullivantia hapemanii* (Coult. & Fish.) Coult. **var. *hapemanii Wyoming or Hapeman's Sullivantia Saxifragaceae (Saxifrage Family)**

Status

Heritage Rank: Global Rank - G3; Idaho - S2; Montana - S2; Wyoming - S3 [Medium conservation priority].

Legal Status: USF&WS – former C2 (dropped as a candidate with the elimination of the C2 program); BLM (MT) – Watch; USFS (WY) – Sensitive.

Figure 31. Illustration of *Sullivantia hapemanii* var. *hapemanii*

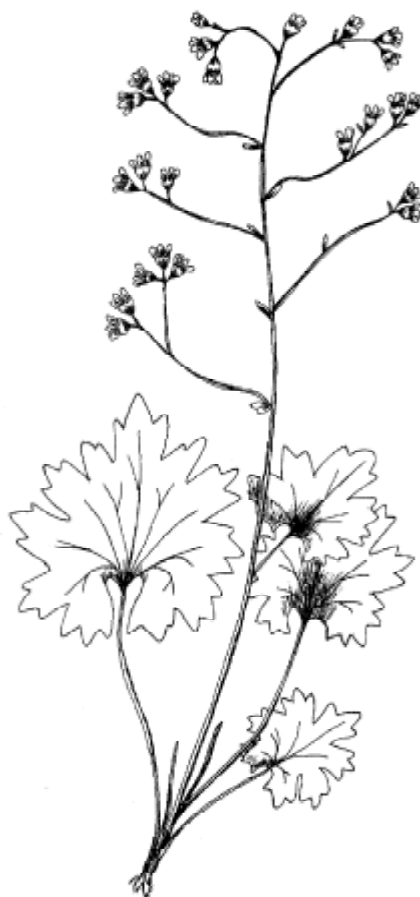


Illustration by Walter Fertig
From "Wyoming Rare Plant Field Guide"

Description

Description: Wyoming *Sullivantia* is a perennial with flowering stems 10-60 cm tall arising from fibrous roots (Figures 31, 32). Basal leaves are 1-10 cm broad, incised with 5-13 lobes for 1/3-1/2 of the blade length, and margins are toothed; stem leaves are reduced and 1-few. Foliage is glandular-pubescent. Flowers are borne in an open inflorescence with side branches at right angles to the main axis, with 5 white petals, 5 stamens, and a glandular calyx. The capsule is 2-celled, narrowly cylindrical at maturity, 4-8 mm long, and 1.5-2.7 mm wide (Soltis 1991, Fertig 1993, Dorn 1992).

Figure 32. Photo of *Sullivantia hapemanii* var. *hapemanii*



Photo by Bonnie Heidel

Similar Species: This is the only species of *Sullivantia* in our area, distinguished from species in the *Saxifraga* genus by 5 stamens rather than 10. The open inflorescence with its spreading branches distinguishes it from other genera in the Saxifrage Family. The one other variety of this species, *Sullivantia hapemanii* var. *purpusii*, is restricted to Colorado and is distinguished in having an elongate fruiting capsule over 2.5 times longer than broad at maturity (Soltis 1991).

Flowering/Fruiting Period: Flowering in late June – late July or August.

Range and Habitat

Range: Wyoming *Sullivantia* is a regional endemic of the Bighorn Mountains in north-central Wyoming and the contiguous Bighorn Canyon area of south-central Montana; with disjunct sites in Wind River Canyon and Casper Mountain in Wyoming and disjunct in the

Figure 33. Montana and Wyoming county distribution of *Sullivantia hapemanii* var. *hapemanii*

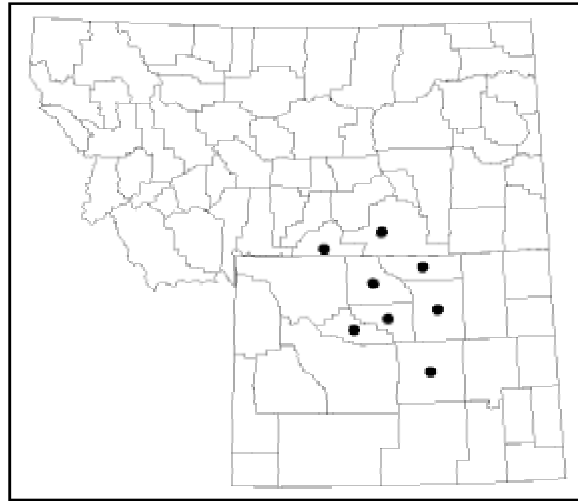
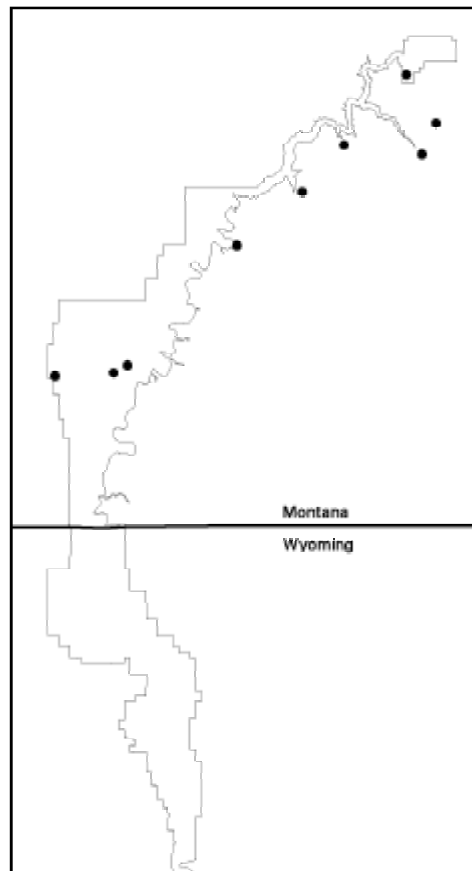


Figure 34. Distribution of *Sullivantia hapemanii* var. *hapemanii* in Bighorn Canyon NRA



Middle Fork of the Salmon River in central Idaho. Bighorn Canyon populations are widely scattered along the length of the canyon in Big Horn and Carbon counties, Montana. Populations at the north end are on or directly above the Reservoir and lower reaches of major tributaries, from Big Bull Elk Creek to Yellowtail Dam, while populations in Carbon County are set back over a mile from the Reservoir in association with small tributaries, from Layout Creek to Davis Creek. In this area, it is known from nine sites. All previous collection sites based on Lichvar et al. (1984) and specimens on file at the herbaria of the University of Montana and the University of Wyoming (MONTU and RM, respectively) were relocated and precisely mapped, with the exception of one that is apparently on tribal land off of the Ok-A-Beh Road. In addition, a database on spring locations is being developed by NPS staff and the nine sites that had been mapped to date were visited. Other NPS staff were consulted on additional spring locations. Finally, springs were sought in streamcourse traverses, by seeking out “amphitheater settings” and wetland vegetation that indicates spring habitat.

Habitat: The species grows at calcareous springs and seeps on canyon walls and streambanks, plus boulder-lined streamcourses and at waterfalls with waters rich in calcium bicarbonate (Figure 35). The springs and seeps represent contact zones between limestone or dolomite and underlying impervious layers, or else groundwater discharge along fault lines. Some of the most distinct settings are “amphitheaters,” grotto-like settings where *Sullivantia hapemanii* var. *hapemanii* covers cavernous interior walls. It occurs at foothills and montane zones from 3,650 ft to 7,400 ft in elevation.

Figure 35. Spring-fed habitat of *Sullivantia hapemanii* var. *hapemanii*



Photo by Bonnie Heide

The settings are often on north-facing slopes, in the shade of rock overhangs, or under tree and shrub canopy; but include a few with partial or full sun. The thing that they all have in common is water percolation or surface flow that saturates the soil in most or all of the growing season. The species is characterized as a wetland obligate (USDI Fish and Wildlife Service 1993), variously growing as an emergent with the base of its stem submerged, on sheer wet slopes, or in mats of aquatic mosses that wick the moisture. The rooting materials include calcium carbonate-rich precipitate, and loose gravel. In any case, it is unconsolidated, and held together at least in part by the intertwined roots of *Sullivantia hapemanii* var. *hapemanii* and sometimes also mosses.

In its best-developed seep habitat, this species is the most abundant vascular plant, and can form 100% cover. Such habitats were called “*Sullivantia* seeps” by Lichvar et al. (1985), a rare habitat dominated by a rare plant. Common associated herbaceous species include: *Carex aurea*, *Aster foliaceus*, *Catabrosa aquatica*, and *Glyceria striata*. Mosses are abundant in most of the habitats where it is found.

In its best-developed riparian habitat, it grows at the edge of streams in wooded, shrub-lined riparian corridor with *Betula occidentalis*, *Acer negundo*, *Acer glabrum*, *Populus angustifolium*, and *Physocarpus monogynous*.

In Idaho, *Sullivantia hapemanii* var. *hapemanii* is found on wet granitic outcrops associated with waterfalls or dripping water (Robert Moseley personal communicated reported in Fertig 1993). It is found in a similar environment at Shell Falls in Wyoming, but all other populations in Wyoming are on limestone or dolomite substrates. One of the Bighorn Canyon occurrences was described from an anomalous “open grassy slope” habitat, and it was not surveyed because it is apparently on tribal land. But it is presumed that the habitat description on the collection label corresponds with the overall setting rather than the micro-habitat, and that the species was probably occurring at a plateau spring or seep as was noted from road.

The seeps supporting *Sullivantia hapemanii* var. *hapemanii* are the largest, most stable, coldwater seeps present in the study area. There is a second kind of wetland seep community present that does not support this species and which dries out at the surface over the growing season.

Abundance

Population size: There are totals of 26 known occurrences and 1 historic occurrence of Wyoming *Sullivantia* in Wyoming, 9 in Montana, and 5 in Idaho. Population sizes are highly variable, ranging in magnitude from less than 10 to over 100,000, as documented in earlier studies (Marriott and Jones 1989, Fertig 1993), and in this study. Population size depends both on available habitat and its intactness. It is important to bear in mind that population densities also vary greatly between occurrences, and that some of the “larger” populations are restricted to one or few small areas that are less than 10 meters square.

Bighorn Canyon NRA includes some of the largest known populations. Its population numbers and distribution patterns are characterized as follows.

inundation, grazing practices prior to NRA establishment, and water developments (discussed in the following text).

Management

Threats: Wyoming *Sullivantia* is often in remote settings that have few direct threats. The primary threat to *Sullivantia hapemanii* var. *hapemanii* is change in water quality and flow. It has a narrow ecological amplitude and occupies a fragile habitat that is directly affected by any changes in the ground-water discharge and streamflow conditions, with unconsolidated substrate that is vulnerable to the slightest amount of trampling.

In Bighorn Canyon NRA, the effects of Yellowtail Dam construction are not known. The only springs that are mapped on the study area geology map

Table 3. Population sizes of *Sullivantia hapemanii* var. *hapemanii* in Bighorn Canyon NRA

Site	Population Magnitude	Extent
East Cabin Creek	10,000+	Common along two adjoining streamcourses; survey incomplete
Ok-A-Beh Road area	Not surveyed	Tribal land
Black Canyon	100+	Uncommon along Black Canyon Creek; survey incomplete
Trail Creek	1,000+	Abundant on very small, north-facing seep
Box Canyon	1,000+	Common among talus of seep above highwater mark, extensive but uncommon at springs above rim of canyon cliff, and associated small streams and fissures below
Layout Creek	100,000+	Common to abundant at large spring system at head of creek
Hillsboro	100+	Occasional to common in three small seep areas
Big Bull Elk Canyon	1,000+	Common at small spring system midslope on canyon
Black Canyon Creek	100+	Uncommon along small streamcourse

Trends: Population numbers tend to remain stable in such a stable wetland habitat barring disturbance or very long-term change in climate and hydrology. Most Wyoming populations are considered to be stable. The habitat, however, is easily disrupted and population numbers have probably declined where habitat disruption has occurred. Three forms of habitat alterations have occurred in Bighorn Canyon NRA where there are likely to have been declines and losses among some Bighorn Canyon populations due to

(Richards 1955) were along the river directly above Yellowtail Dam. This was perhaps the largest spring in the Bighorn Canyon and the species occurs at all of the large intact springs. Populations would have been flooded if entire spring and seep habitats were submerged, and populations along streamcourses were probably inundated in their lower reaches as at East Cabin Creek and Black Canyon Creek. Even the populations above highwater mark are potentially affected. For example, there had been a large, charac-

teristic “Sullivantia seep” described in an “amphitheater setting” in Box Canyon across from Yellowtail Dam by Lichvar based on his visit in 1983 (Lichvar et al. 1984). It lies directly above highwater mark. When it was revisited in 1999, there were still hundreds of plants present, but there were no “mounds of calcareous precipitate” much less a “floor” but instead a loose unconsolidated slope. Based on the original description, it is possible that parts of the amphitheater walls have deteriorated and collapsed. If there were any photos of the Box Canyon amphitheater that had been taken at least 10+ years ago, they would be useful to compare directly with current conditions.

It may also have been affected at least locally by some combination of water developments. The well that supplies water to the Ok-A-Beh Marina was installed at one end of an extensive seepage system along a bench near the Canyon rim. The system has several major springs spread out for over a mile, with streams and rivulets below the largest of these that cross the Om-ne-a Trail.

Not all springs and seeps are remote. Indirect trampling disturbance to the species was likely at its Hillsboro population when it was an active dude ranch before creation of Bighorn Canyon NRA. A complex of seven springs lie above Hillsboro. The three that are farthest away are in an “amphitheater,” representing a natural corral and watering hole for stock. While the nearly vertical walls of the amphitheater are not subject to trampling, they are half-buried in dirt that may have resulted from trampling at their base. Rank emergent vegetation grows below the springs in what may have been potential habitat. There are three small population remnants in the amphitheater but none at the other springs. In addition, a road was paved directly above the rim of the “amphitheater” springs, perhaps lending to destabilization if not also changing the groundwater flow.

Similarly, the Davis Ranch and Snell Ranch headquarters were logically located among springs. *Sullivantia hapemanii* var. *hapemanii* does not occur at the developed and impounded springs in these settings, sites where the species may have been extirpated.

Protection Status: Four populations of the species are protected in the Five Springs and Spanish Karst ACECs managed by the BLM, the Shell Canyon RNA

of Bighorn NF, and Amsden Creek Wildlife Habitat Management Area. It is also found in The Nature Conservancy’s Tensleep Preserve and seven TNC conservation easements in Wyoming. Idaho populations lie within the Salmon River Wilderness Area. Though it is relatively well-protected across its range, Bighorn Canyon NRA is important because it protects populations that are distant from others, including seep populations of large numbers, and stream populations of great extent.

Land Ownership: In Wyoming, populations have been documented on lands managed by Bighorn National Forest, the BLM Buffalo, Cody and Worland Field Offices, the Amsden Creek Wildlife Habitat Management Area, and on private lands. All Montana occurrences are on or contiguous with Bighorn Canyon NRA. One of the collection sites along Ok-a-Beh Road was not resurveyed because it lies on Crow Indian Reservation. The one running above Ok-A-Beh Marina and Yellowtail Dam is shared with Crow Indian Reservation. There are also populations on year-round streamcourses at Black Canyon Creek and Cabin Creek that are likely to extend onto Crow Indian Reservation.

Management Comments: The habitat of *Sullivantia hapemanii* var. *hapemanii* is susceptible to disturbance and was reduced prior to Bighorn Canyon NRA establishment. Its spring and seep habitat is most susceptible. Thus, it is a priority for recognizing as a special habitat management concern. Spring and seep habitats are currently being mapped within Bighorn Canyon NRA as reference in management planning. We recommend that intact spring habitats harboring this species be recognized as highly vulnerable for all management planning purposes.

New recreation developments should not lead visitors directly to the fragile habitat of this species. The Om-ne-a Trail at the north end skirts subpopulations at springs and seepage zones. Any trail work is to be conducted with wetland integrity in mind, and trail interpretive information should include general messages about leaving plants and other pieces of the landscape in place for others to enjoy.

One population of *Sullivantia hapemanii* var. *hapemanii* lies beside the Trail Creek Campgrounds. It is on the opposite (south) side of Trail Creek, across from a picnic table at a bend where the creek flows

over a plate of sandstone bedrock. It is surprisingly intact, and while the current recreational design does not signify a direct threat, any foot traffic on the steep seepage slope could destabilize it. One misplaced footstep at the base of it this past year nearly tore out a piece of the vegetation mat made up of this species, and the rest of the highly restricted population is just as vulnerable. Natural impediments to streamside foot access at that point might reduce accidental damage. It is on a nearly vertical slope where the population reaches down to the stream, so it is also affected by natural or accelerated stream erosion on Trail Creek, and the bottom fringe of the population was eroded out in the spring of 1999.

Stable groundwater and surface flow conditions are needed to maintain stable populations, and any water developments in the watershed should be evaluated in light of their potential impact. Groundwater and reservoir/stream management decisions at the north end of Bighorn Canyon NRA potentially affect this species. Pre-1990 photos of the Box Canyon “amphitheater” are to be sought to determine more accurately the extent of habitat change and to help identify if there are any restoration options. Similarly, an annual photo point monitoring or close visual inspection of the Trail Creek population across from a campground is needed to gauge whether recreation use is occurring. It may be desirable to locate shrub plantings or downed timber to shift the public access from the campground to the stream away from the small spring on the other side.

The species’ habitat is not currently used by cattle or horses. New levels of use or water developments for livestock are potential threats to the species. The only places where a population occurs in a livestock allotment is above Yellowtail Dam extending onto tribal land, where stock use is low or absent because there is better access to water elsewhere in the pasture. The potential for restoring habitat and populations numbers above Hillsboro warrants where there has been a long history of livestock use warrants consideration.

Bighorn Canyon NRA Significance

Wyoming *Sullivantia* was first documented on Bighorn Canyon by Robert Dorn at Trail Creek in 1976. The work of Lichvar et al. (1984) documented the species at the north end of Bighorn Canyon and included a revisit to Trail Creek site in the south end. The species was subsequently found on Layout Creek by Lesica and Winslow (EO #007). We surveyed all known populations, as well as all mapped and reported springs, to precisely locate and compare sites. Only two additional populations were found.

Big Horn Canyon NRA harbors less than a quarter of all known populations of the species rangewide. While many of its sites elsewhere are protected and remote, the Bighorn Canyon NRA populations are distant from all others and their protection lends to rangewide, long-term viability. Thus, it is recommended for consideration by the National Park Service as a rare species, emphasizing conservation of its spring and stream habitats.

State Rare Plants

Agrimonia gryposepala Wallr. Common agrimony Rosaceae (Rose Family)

Status

Heritage Rank: Global Rank - G5; Montana - SU (watch); Wyoming - S1 [Low Conservation Priority]
Note: The species was added to the watch list for Montana based on this and other studies.

Legal status: USF&WS - None. BLM - None. USFS - None.

Description

Description: Common agrimony is a perennial 30-150 cm tall with 1-several stems in small clumps arising from short, stout rhizomes and long fibrous roots. Leaves are alternate, divided, coarsely-toothed, and glabrous above, with glands and hairs along the veins below. The yellow flowers are borne in a simple, elongated inflorescence with stalked flowers; they have 5 petals that are 3-5.5 mm long, and usually 15 stamens. The fruit is furrowed and shaped like a top or half-sphere, with rows of blunt, hooked bristles in rings on top; the outer ring usually reflexed. The achene is globose and 2.8-3.3 mm in diameter (Great Plains Flora Association 1986).

Similar Species: It resembles the more widespread *Agrimonia striata* from which it is distinguished by the absence of hairs in the furrows, and the presence of glands along the axis of the inflorescence. The latter species was documented in Bighorn Canyon as part of this study.

Flowering/Fruiting Period: Flowering in July, fruiting in August. Fruits are needed for positive identification.

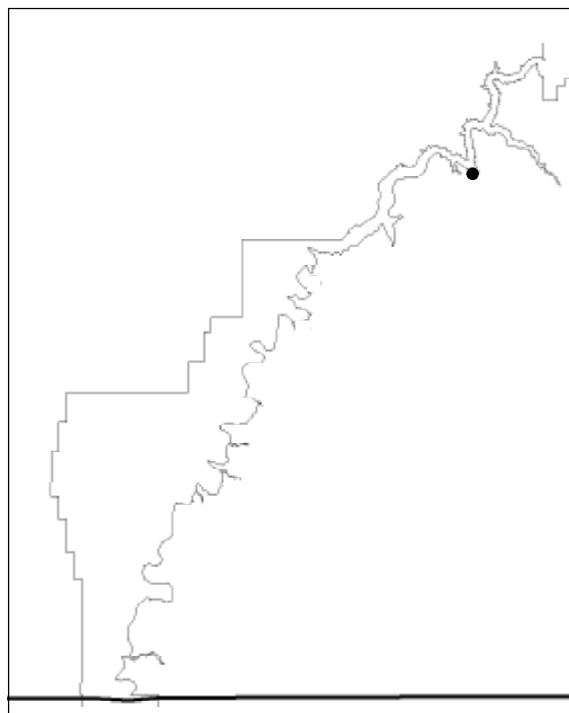
Range and Habitat

Common agrimony is widespread in eastern North American from Maine to Ontario and North Dakota, south to Kansas and North Carolina. It is reported for California and New Mexico (Great Plains Flora Association 1986). The collections of this species at East Cabin Creek in the north end of Bighorn Canyon

Figure 36. Montana and Wyoming county distribution of *Agrimonia gryposepala*



Figure 37. Distribution of *Agrimonia gryposepala* in the Montana portion of Bighorn Canyon NRA



NRA by Lichvar (#6385) and Collins (#871) were not recognized as new additions to the Montana flora until this study. It has since been collected in northeastern Montana (Sheridan Co.; Heidel et al. in progress.) In Wyoming, it is known from the Black Hills and the east slope of the Wind River Range.

Abundance

No information on abundance is available from the collection record. Species of *Agrimonia* are often found in low numbers.

Management Recommendations

Study area data are needed before making management recommendations. It may be a riparian corridor species of perennial spring-fed streams, with limited potential habitat inside NRA boundaries.

Arabis demissa Greene **var. *languida*** Rollins

Daggett rock cress

Brassicaceae or Cruciferae (Mustard Family)

Status

Heritage Rank: Global Rank - G4T4; Montana - S1; Wyoming - S2 (not tracked)

Note: This species was dropped as a species of concern in Wyoming in 1999 because it is more widespread in the state than previously recognized (Fertig and Beauvais 1999).

Legal Status: USF&WS Status - None; BLM Status - None; USFS Status - None.

Description

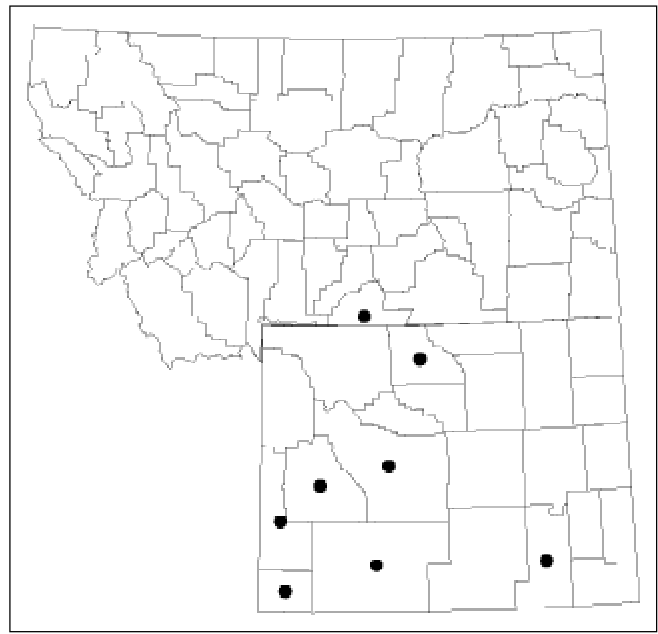
Description: Daggett rock cress is a perennial with multiple flowering stems 10-30 cm tall, arising from clusters of basal leaves surmounting a simple or branched rootcrown. Stems are usually unbranched, and often decumbent. Basal leaves are lance or narrowly spoon-shaped, with entire margins and pointed tips, and are about 1.5 cm long. The scattered stem leaves are 5-10 mm long, sessile, and have small lobes at their bases. The basal leaves, lower stem, and lower stem leaves are usually sparsely hairy with large simple and forked hairs, though in rare cases, they may be almost hairless. Flowers have 4 erect, greenish or purple-tinged sepals, 4 spreading, white to purplish, spatula-shaped petals that are 4.5-6.5 mm long and 1.5-2 mm wide, 6 stamens, and a single pistil. The siliques are 2-4 cm long and are descending or pendulous, arising from 4-7 mm long stalks that arch downward from the stem. The flattened, round,

wingless seeds are in one row in each of the 2 chambers of the capsule (Rollins 1993).

Similar species: This species is distinguished from most other *Arabis* in Montana by its coarse hairs and siliques that are pendulous or arch downwards with wingless or narrowly-winged seeds in one row within each cell of the capsule. It differs from *A. holboellii* in having basal leaves with loose, spreading hairs that are unbranched or merely forked (Dorn 1992). In Wyoming, it cannot be reliably distinguished from *A. fendleri* without fully-ripe fruit. Additional study is needed to confirm that these two taxa are truly distinct in the state.

Flowering/Fruiting Period: Flowering in May, fruit maturing in June.

Figure 38. Montana and Wyoming county distribution of *Arabis demissa* var. *languida*

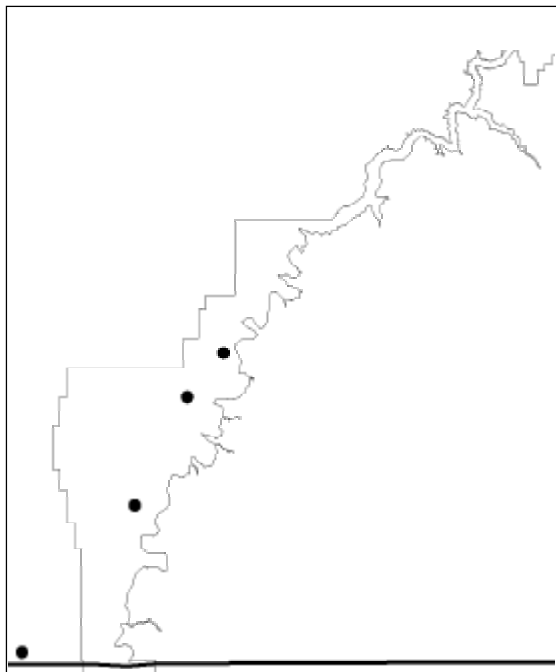


Range and Habitat

Daggett rock cress is known from Wyoming, Colorado, and eastern Nevada (Rollins 1993). It was only more recently recognized as part of the Montana flora, documented in the foothills of the Pryor Mountains area (Lesica et al. 1998). It grows in canyon bottoms and outwash plains with dry, stony soils derived from limestone, often in juniper woodland. Its earlier documentation in the Bighorn Canyon NRA (Lichvar et al. 1985) included Montana stations, and it was also

reported from the juniper woodland, limber pine, and sagebrush steppe vegetation types in the study area by Knight et al. (1985).

Figure 39. Distribution of *Arabis demissa* var. *languida* in the Montana portion of Bighorn Canyon NRA



Abundance

There are 3 known occurrences in Bighorn Canyon based on vegetation sampling data of Knight et al. (1985), in addition to two elsewhere in the Pryor Mountains desert. The species made up 0.1-0.2% of total vegetation cover, indicating that it was not common.

Management Recommendations

Study area data is needed before making management recommendations.

Aster glaucodes Blake

Gray aster

Asteraceae (Aster Family)

Status

Heritage Rank: Global Rank - G4G5; Montana - S2S3 (no longer tracked); Wyoming - S3 (not tracked) Note: This species was reranked in Montana from S1 based on results of this study.

Legal Status: USF&WS Status - none; BLM Status - none; USFS Status - none.

Description

Description: Gray aster is a perennial with simple or branched, mostly hairless stems that are 20-70 cm tall, and arise from rhizomes with many stems forming colonies. There are numerous alternate, stalkless, entire- margined leaves that are 4-12 cm long by 0.5-2.5 cm wide and are hairless and glaucous. The lowermost leaves are smaller and scale-like. The flowers are borne in several to many composite heads of ray and disk flowers surrounded by an involucre of bracts borne on spreading branches. The involucre is 6-9 mm high and is composed of several series of overlapping bracts; the outer bracts are broad and firm, and the inner bracts are narrower and longer and often have purplish tinged midribs. The 8-19 strap-shaped rays are pale lavender and 8-18 mm long by 1-2 mm wide. The disk is 7-12 mm in diameter and consists of numerous flowers with tubular corollas that are shorter than the rays. The bases of both ray and disk corollas are encircled by a pappus of slender white bristles. Achenes are hairless or sparsely short-hairy near their tip (Cronquist 1994).

Similar Species: It is distinguished from other *Aster* species in Montana and Wyoming by the combination of the rhizomatous perennial habit, glabrous stems and glaucous leaves, and an involucre of broad stiff bracts that are green only on the midrib and tip.

Flowering/Fruiting Period: Flowering in early August.

Range and Habitat

Gray aster has its center of distribution in the Central Rockies, extending from south-eastern Idaho and south-central Montana to northern Arizona. In Montana, it is known only from the Pryor Mountains

where it was first discovered in 1995 (Lesica et al. 1998). There have not been Pryor Mountains species surveys late in the growing season when this species is in flower, and its distribution is likely to be incompletely documented.

Figure 40. Montana and Wyoming county distribution of *Aster glaucodes*

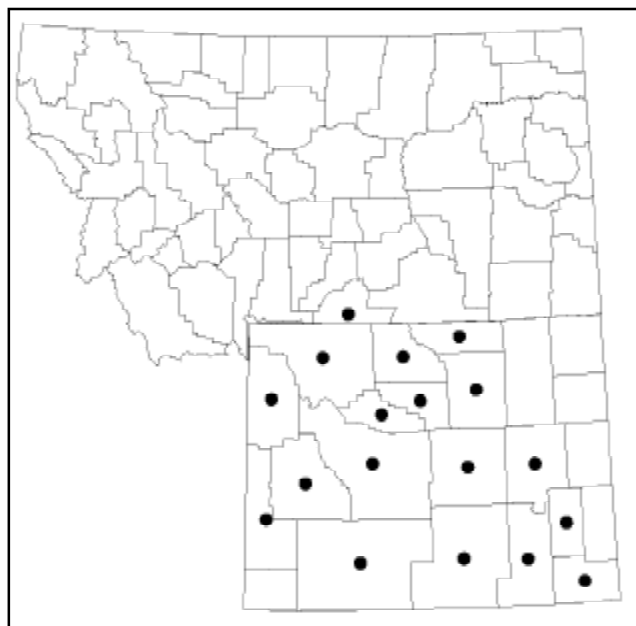
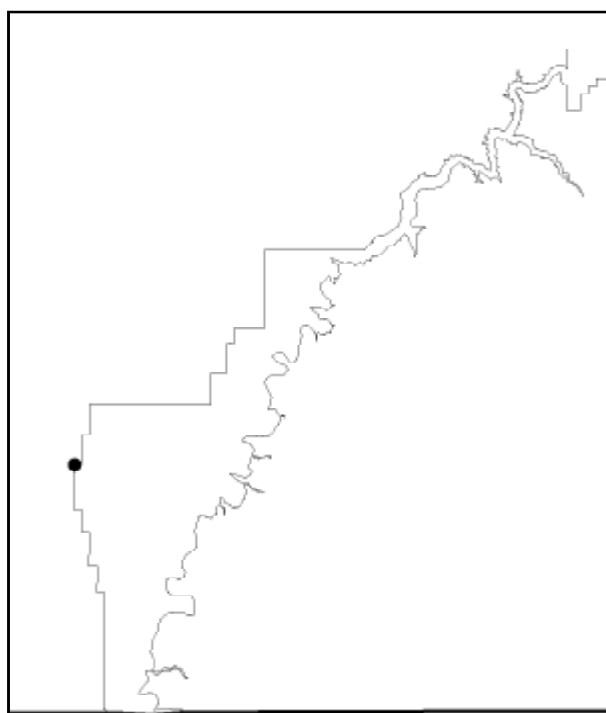


Figure 41. Distribution of *Aster glaucodes* in the Montana portion of Bighorn Canyon NRA



It is a montane woodland species restricted to limestone outcrops and shallow soils with limestone parent material. It grows in shade, as well as in partial sun around small outcrops, margins of roads, and in the open canopy found along ridge tops, where it is found in higher density than in shade. On the south side of the Pryor Mountains, it seems to be associated with the prevalent forest types dominated by *Pseudotsuga menziesii* as reported in DeVelice and Lesica (1993). Other common associated species include *Leucopoa kingii*, *Juniperus compressa*, and *Poa rupicola*.

Abundance

The species presence in the study area represents the fringes of an extensive population on Sykes Ridge, where it was found recurrently on six sections of adjoining land in a nearby study.

Management Recommendations

No management needs were identified for Gray aster. The species has been shown to be more widespread than previously known and lacking threats, thus it has been moved to the watch list in Montana. It showed no signs of being browsed or grazed.

***Astragalus aretioides* (M.E. Jones)**

Barneby

Sweetwater milkvetch

Fabaceae (Bean Family)

Synonym: *Astragalus serioleucus* Gray var. *aretioides* Jones

Status

Heritage Rank: Global Rank - G4; Montana - S2; Wyoming - S3 (not tracked)

Legal Status: USF&WS Status - None. BLM Status (MT) - Watch. USFS Status - None.

Description

Description: Sweetwater milkvetch is a long-lived perennial with short, profusely branching stems that form mounded cushions that are 10-30 cm in diameter. Leaves are pinnately compound, 6-15 mm long and have 3 narrowly lance-shaped leaflets and a prominent papery sheath around the petiole where it meets the stem. Foliage is densely covered with silky hairs.

Figure 42. Illustration of *Astragalus aretioides*



Illustration by Bobbi Angell
From "Intermountain Flora"

Figure 43. Montana and Wyoming county distribution of *Astragalus aretioides*

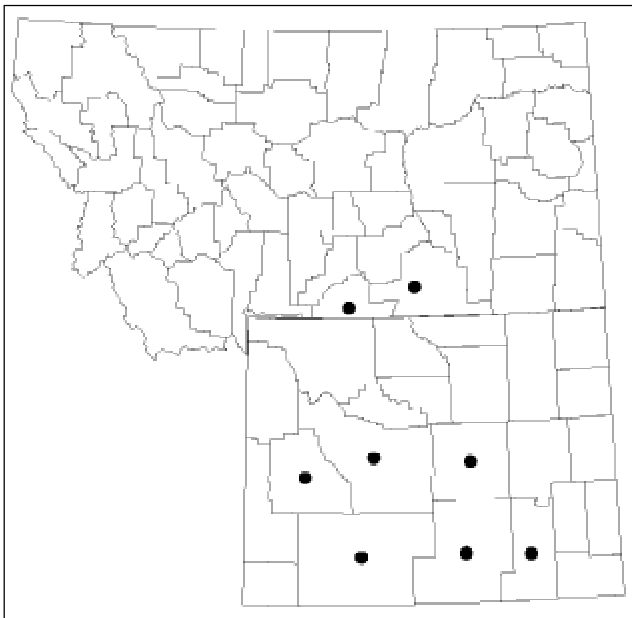
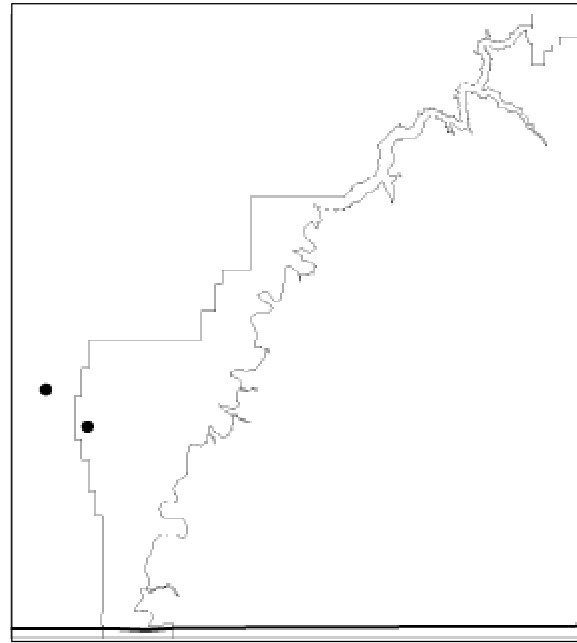


Figure 44. Distribution of *Astragalus aretioides* in the Montana portion of Bighorn Canyon NRA



Pea-like, magenta flowers are paired on short stems among the leaves. The upper petal is 6-8 mm long and partly reflexed upwardly. The calyx is 3-4 mm long. Fruit pods are narrowly egg-shaped, 4-5 mm long, densely silky and hairy, and are usually hidden among the leaves (Barneby 1989).

Similar Species: The combination of purple flowers and a calyx less than 5 mm long separate *Astragalus aretioides* from other cushion-forming 3-leaflet species in our area including *A. barrii*, *A. gilviflorus*, and *A. hyalinus*. The latter is widespread in Bighorn Canyon.

Flowering/Fruiting Period: Flowering mid June-mid July; prolonged into August under some conditions.

Range and Habitat

Sweetwater milkvetch is a regional endemic of central, southwestern and south-central Wyoming, and south-central Montana. In Montana, it is known mainly from the Pryor Mountains area, Carbon County. In Bighorn Canyon NRA, it grows on a steep-sided spine-like ridge above Layout Creek as an outlier of a larger ridgetop population. In addition, two 1953 collections were made on the same day in Big Horn County, at "Grapevine Dome" and on the north side of the canyon, at the rim. After survey in the NRA, it is believed that these collection sites were outside of NRA boundaries.

It grows on thin, usually limestone-derived soil of exposed ridges and slopes from app. 4400 –7800 ft, in the foothills and montane zone. The Pryor Mountains occurrences are in openings among *Pseudotsuga menziesii* associated with *Eritrichium howardii*, *Shoshonea pulvinata*, *Petrophyton caespitosum*, and *Hymenoxys acaulis*. The steep habitat where it occurs in Bighorn Canyon has limited cushion plant community development. The only low elevation occurrences (below 6,000 ft) are those from Grapevine Dome where its habitat in open terrain would be expected to have differences in composition if not structure.

Abundance

There are seven records of Sweetwater milkvetch in Montana. The smallest are populations of about 50 plants. Population sizes were not estimated at the two sites where it was described as common, including the Grapevine Dome record. The presence of *Astragalus aretioides* at the head of Layout Creek represents the fringes of a more extensive population on Sykes Ridge. Less than 20 plants were found on the spine of a finger ridge.

Management Recommendations

Sweetwater milkvetch is a species confined to remote habitat in the study area. It is among a set of higher priority species for coordination with BLM in management affecting Sykes Ridge and the escarpment face of the Pryor Mountains. Its earlier documentation in Big Horn County may have been outside of the Bighorn NRA boundaries.

Astragalus geyeri Gray var. *geyeri* Geyer's milkvetch Fabaceae (Bean Family)

Status

Heritage Rank: Global Rank - G4?T4?; Montana - S2; Wyoming - S3 (not tracked)

Legal Status: USF&WS Status - None. BLM Status (MT) - Watch. USFS Status - None.

Description

Description: Geyer's milkvetch is an annual with spreading to erect stems 5-20 cm tall. Leaves are 2-10

cm long, with 5-13 linear to oblanceolate leaflets covered with short hairs (Figure 44). The 2-8 flowered inflorescences arise in the leaf axils and are overtopped by the leaves. Flowers are 6-8 mm long, and whitish with pink or violet veins or hues. The pod is sessile, ca. 2 cm long, membranous, glabrous, and inflated in a half-ellipsoid shape to form a single chamber (Barneby 1964, Barneby 1989, Hitchcock and Cronquist 1961.)

Figure 45. Illustration of *Astragalus geyeri* var. *geyeri*



Illustration by Jeanne R. Janish
From "Vascular Plants of the Pacific Northwest"

Similar Species: *Astragalus lotiflorus* and *A. ceramicus* resemble *A. geyeri* in growth form and affinity to sandy habitat, but are perennial. *Astragalus lotiflorus* also differs in having dolabriform hairs on the foliage, and a hairy pod. *Astragalus ceramicus* differs in having linear leaves, and a pronounced mottling pattern on the pod. The one other variety of this species, *Astragalus geyeri* var. *triquetrus*, is restricted to Arizona and Nevada.

Flowering/Fruiting Period: Flowering in June; fruiting in late June-July.

Figure 46. Montana and Wyoming county distribution of *Astragalus geyeri* var. *geyeri*

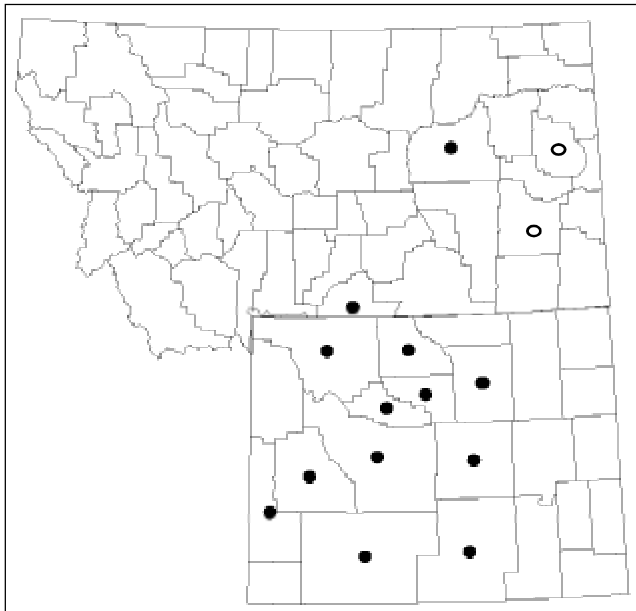
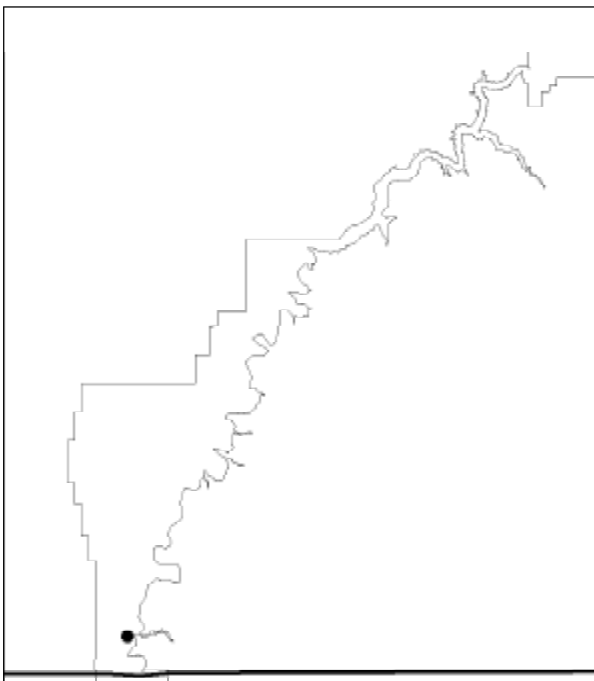


Figure 47. Distribution of *Astragalus geyeri* var. *geyeri* in the Montana portion of Bighorn Canyon NRA



Range and Habitat

Geyer's milkvetch is a Great Basin species known from southeastern Oregon to California, and east to Montana, Wyoming, and Utah. In Montana, it is

known from Carbon County, an outlying occurrence in Garfield County, and historical collections in Custer and Dawson counties that have not been relocated.

This species is restricted to well-drained sandy settings. In the Pryor Mountains desert it occupies sandy soils of alluvial plains and terraces, frequently found on the Chugwater Formation. The habitat is typically dominated by *Artemisia tridentata*/*Stipa comata*; but the species is also present in *Juniperus osteosperma*/*Artemisia tridentata*, *Artemisia tridentata*-*Atriplex gardneri*, and *Sporobolus cryptandrus* – *Boutleoua gracilis* plant associations (Lesica and Achuff 1992). In Garfield County it grows on loose sand eroded out of sandstone caprock. In Bighorn Canyon NRA, it occurs in an isolated pocket of sand blowout within dense cover of *Artemisia tridentata*, associated with *Oryzopsis hymenoides*, *Oenothera alba*, *Eriogonum cernuum*, and *Opuntia polyacantha*.

Abundance

Population numbers range from fewer than 10-1000+. As an annual, numbers fluctuate from year to year by at least an order of magnitude. The study area population has the lowest reported population numbers of the species in Montana and is highly restricted.

Management Recommendations

It appears that the study area blowout conditions are maintained by wild horse use. The surrounding setting of *Artemisia tridentata* lacks understory vegetation and is among the few areas that appear to be distinctly overgrown among Bighorn Canyon NRA shrub/steppe communities. It is possible that *Astragalus geyeri* var. *geyeri* was present throughout a much more open landscape under natural conditions, or that the blowout habitat for it is an “unnatural” setting created by wild horse use. Information is needed on the land use history of this area to further evaluation whether it occupies “natural” habitat.

***Astragalus oreganus* (Nutt.)**
Wind River milkvetch
Fabaceae (Bean Family)

Status

Heritage Rank: Global Rank - G4?; Montana - S1; Wyoming - S3 (not tracked)

Note: The global rank is under review and may be changed to "G3?" reflecting known abundance in the two states making up its entire range.

Legal Status: USF&WS Status - None. BLM Status (MT) - Watch, USFS Status - None.

Description

Description: Wind River milkvetch is a perennial with lax stems 6-20 cm long that arise from deep, cord-like rhizomes (Figure 47 SID 1362). Spreading, alternate, pinnately compound leaves are 5-15 cm long with 9-15 broadly elliptical leaflets. Foliage is thinly to densely covered with long, ashen T-shaped (dolabriform) hairs. Spike-like inflorescences, 3-7 cm long, are densely 20-35-flowered and arise from the axils of the upper leaves. Off-white or yellowish, pea-like flowers have a reflexed upper petal that is notched

Figure 48. Illustration of *Astragalus oreganus*



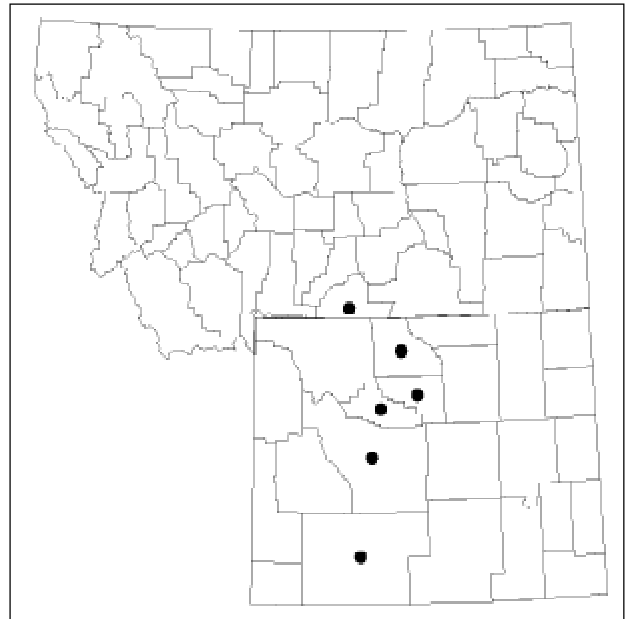
Illustration by Debbie McNiel

at the tip and a calyx that is 6-10 mm long and thinly covered with light-colored hairs. The fleshy, green, oblong pods are 10-15 mm long, round in cross section, and held nearly erect (Barneby 1964).

Similar Species: Distinguished from other species of *Astragalus* in our area by the combination of the broadly elliptic to nearly round leaflets, the dolabriform foliage hairs, and the papery sheaths at the base of the petioles that completely surround the stems (Dorn 1984, 1992).

Flowering/Fruiting Period: Flowering and fruiting in June-July.

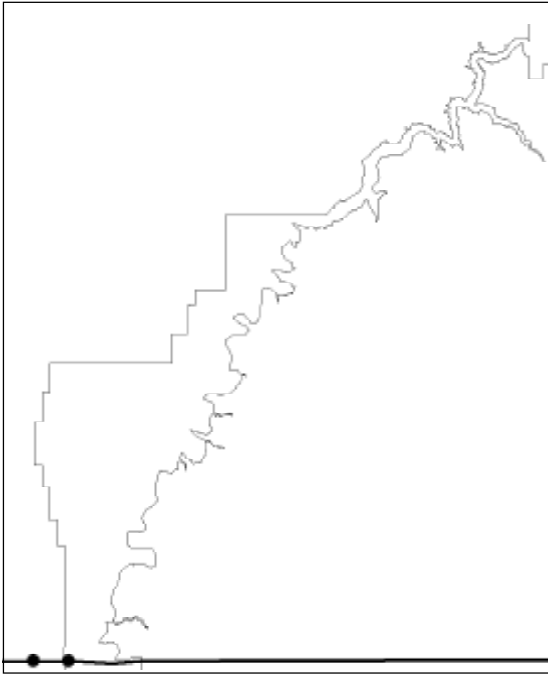
Figure 49. Montana and Wyoming county distribution of *Astragalus oreganus*



Range and Habitat

Wind River milkvetch is a regional endemic of south-central Montana and western Wyoming. In Montana, it is only known from the Pryor Mountain desert area, while it is widely scattered over western Wyoming. It occupies sandy or clayey soil in desert shrublands and sagebrush grasslands, occurring on both Chugwater Formation and Madison Group Formations, most often in *Artemisia tridentata*/*Stipa comata*, but also present in *Juniperus osteosperma*/*Artemisia tridentata* and *Juniperus osteosperma* - *Cercocarpus ledifolius* (Lesica and Achuff 1992). In the study area, it is

Figure 50. Distribution of *Astragalus oreganus* in the Montana portion of Bighorn Canyon NRA



restricted to sparsely-vegetated “red beds” of the Chugwater Formation.

Abundance

Wind River milkvetch is known from six occurrences in Montana. They range in size from rough estimates of 100-3000 plants. The Bighorn Canyon population in Montana consists of over 100 plants; over half were vegetative in 1999. They are clustered in small patches that together total less than an acre. A much larger and more extensive population (numbering in the low thousands) occurs in the Sykes Mountain area and on the east shore of Yellowtail Reservoir on the Wyoming side of the NRA.

Management Recommendations

Wind River milkvetch is located close to a gravel road on the border of the NRA. There were no ORV incursions noted, but it is vulnerable. *Halogeton glomeratus* is present in low numbers along the road and could pose a competition threat. Separate species management needs were not identified.

Carex grvida* Bailey var. *grvida

Pregnant sedge

Cyperaceae (Sedge Family)

Status

Heritage Rank: Global Rank - G5T?; Montana - S1; Wyoming - S2 (not tracked)

Legal Status: USF&WS Status - None. BLM Status - None. USFS Status - None.

Description

Description: Pregnant sedge is a grass-like perennial that forms clumps of stems which reach up to 60 cm high and arise from short root stocks (Figure 50). Leaves are 4-8 mm wide and clustered near the base of the plant. Flowers are clustered in spikes that are ca. 1 cm long; the perigynia occupy most of the spike, but there are a few male flowers at the tip. Spikes are aggregated at the top of the stem and subtended by 2-3 leaf-like bracts that are shorter than the inflorescence. Scales subtending each perigynia are oval, awned, and as long or longer than the perigynia. Perigynia are 4-5

Figure 51. Illustration of *Carex grvida* var. *grvida*



From “New Britton and Brown Illustrated Flora of the Northeastern United States and Canada”

mm long and egg-shaped; they gradually taper into a beak that is serrate on the edges and notched at the tip. There are few or no nerves visible on the outer face of the perigynia. Each perigynium has 2 stigmas, and a lens-shaped achene (Great Plains Flora Association 1986).

Similar Species: Distinguished from *C. hoodii* in having a loose sheath that easily breaks ventrally, and is also prominently septate-nodulose or mottled on the dorsal surface. The awn-tipped scales of the perigynia are also distinctive. A hand lens or microscope and technical key are needed for positive identification. The one other variety of this species, *C. graviora* var. *lunelliana*, does not occur in the northern Rocky Mountain states.

Flowering/Fruiting Period: Fruit mature in July.

Range and Habitat

Carex graviora var. *graviora* is an eastern species extending from Pennsylvania to Virginia, and west from Saskatchewan and Montana to New Mexico. In Montana, it is known only from Big Horn and Rosebud counties. All Wyoming populations of this species are from the Black Hills.

It occurs among deciduous woody vegetation in

Figure 52. Montana and Wyoming county distribution of *Carex graviora* var. *graviora*

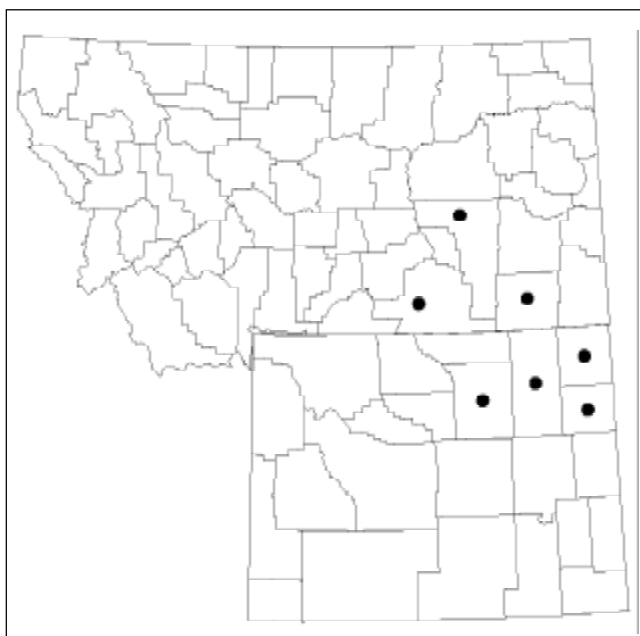
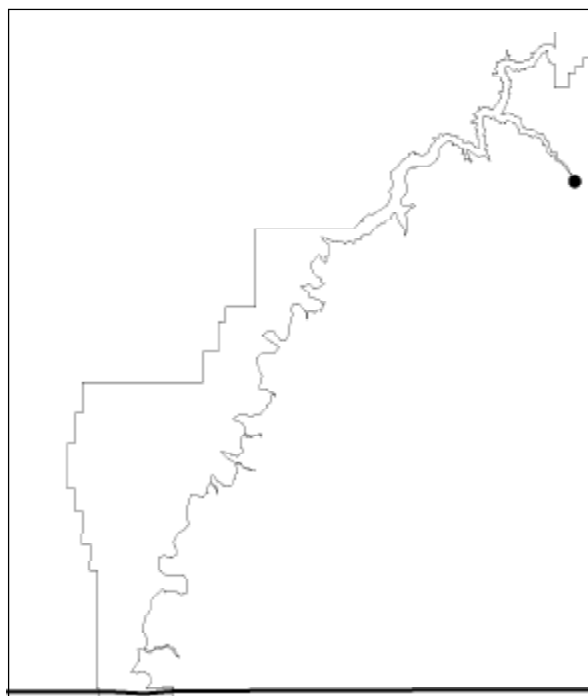


Figure 53. Distribution of *Carex graviora* var. *graviora* in the Montana portion of Bighorn Canyon NRA



riparian corridor and moist ravines. Most Montana occurrences are in isolated green ash ravines and wooded draws lacking surface water surrounded by pine uplands. The Bighorn Canyon occurrence is along Black Canyon Creek, a perennial coldwater stream where *Pinus ponderosa* has a *Prunus virginiana* understory in the valley bottom, and the species was associated with *Agrimonia striata* and *Toxicodendron rydbergii*.

Abundance

There are five occurrences of this species in Montana, and each of them has low numbers of less than 50 plants. In Black Canyon, the species is present in low numbers and density but with vigorous, multi-stemmed clumps. Less than ten clumps were found but survey did not extend upstream.

Management Recommendations

The riparian corridor habitat of Pregnant sedge is laced with fishing access trails, but no immediate management needs were identified. It has limited potential habitat within NRA boundaries and the riparian corridor habitat may extend onto Crow Reservation.

***Cleome lutea* Hook.**
Yellow bee plant
Capparaceae (Caper Family)

Status

Heritage Rank - Global Rank - G5; Montana - S1;
Wyoming - S3 (not tracked)

Legal Status: USF&WS Status - None. BLM Status - none. USFS Status - None.

Description

Description: Yellow bee plant is an annual with simple to branched stems that are 10-30 cm high (Figure 53). The leaves are palmately compound with long, 2-6 cm petioles and 3-5 narrowly lance-shaped, 2-6 cm long leaflets. Foliage is glabrous to sparsely hairy with a thin, pale, waxy coating. The yellow flowers are borne on 10-20 mm long, ascending stalks, and are densely clustered in a globular inflorescence that greatly expands as the fruit matures. Each flower is subtended by a green bract; the lowest ones resemble leaves, while the uppermost are short and narrow. Flowers have a 4-lobed calyx and 4 separate petals that are 5-8 mm long. There are 6 stamens, which are greatly exerted beyond the petals. The pod-like capsules are 1-3 mm long and borne on arching stalks that are as long as the fruit (Hitchcock and Cronquist 1964).

Figure 54. Illustration of *Cleome lutea*



Illustration by Jeanne R. Janish
From "Vascular Plants of the Pacific Northwest"

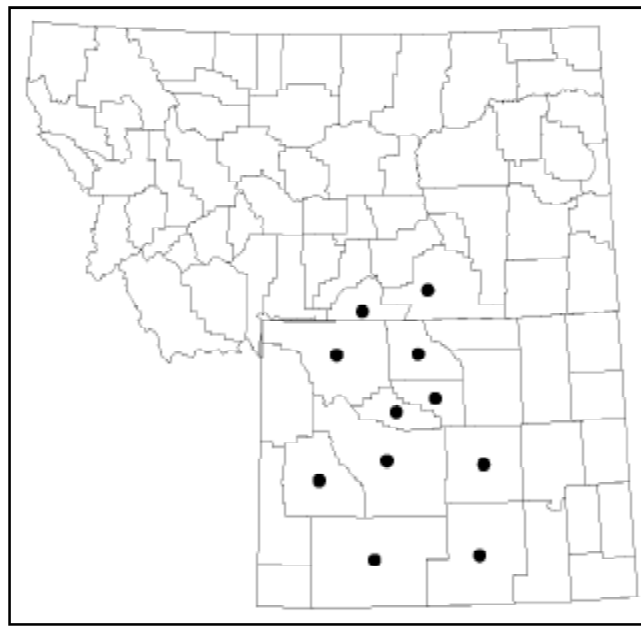
Similar Species: The palmately compound leaves and the bright yellow flowers distinguish this species from the common *Cleome serrulata* that has pinkish flowers.

Flowering/Fruiting Period: It flowers in June to early July; and sets fruit in July.

Range and Habitat

Yellow bee plant is a western species known from eastern Washington to southcentral Montana, and south to California and Texas. In Montana it has been confirmed only from Carbon County. A 1967 collection south of the Dryhead area may have been collected in either Carbon or Big Horn County. It is not known whether the latter is inside or outside of Bighorn Canyon NRA boundaries, but it was later collected in 1976 at the foot of Sykes Ridge. It could not be relocated there in 1998. Fertig observed *Cleome lutea* along a weedy inlet on the eastern shore of Yellowtail Reservoir on the Wyoming side of the NRA in 1998 growing near a colony of *Rorippa calycina*.

Figure 55. Montana and Wyoming county distribution of *Cleome lutea*



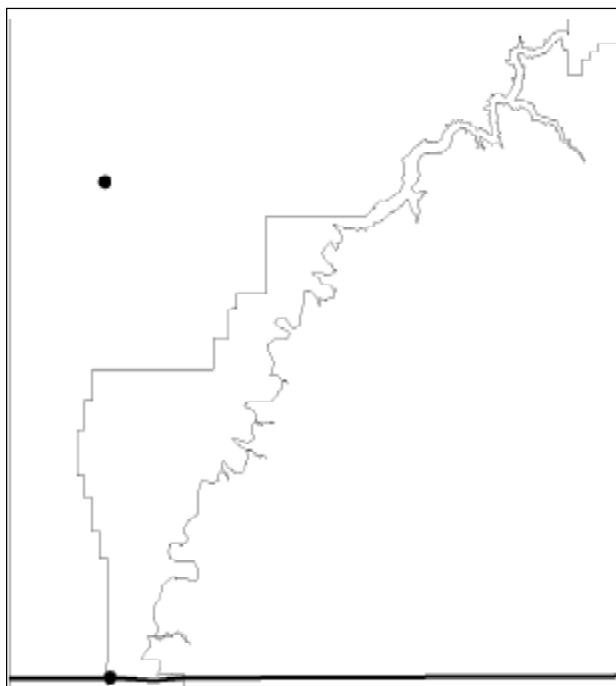
It occupies open, often sandy soil of sagebrush steppe in valleys and plains. In this landscape, its natural habitat is moist places around valleys and springs, and is considered a facultative upland plant in the Great Plains (USDI Fish and Wildlife Service 1994). The

two occurrences in or near Bighorn Canyon are from disturbed places including a roadside (Dryhead), and a spot characterized as a “disturbed area” (base of Sykes Ridge) that may also have been associated with the nearby roadbed or transmission corridor. Note: if the species is viable in man-made disturbance settings, then it will no longer be tracked as a Montana species of special concern. Chance establishment of native species in roadside settings usually does not represent a viable population, but the information is retained insofar as it may reflect species’ presence elsewhere in the landscape.

Abundance

The species is known from six occurrences. The largest known population in Montana had numbers fluctuating from 1-1000 plants in consecutive years. It may persist under adverse conditions by its seedbank. The other collection sites for this species did not have number estimates or had numbers less than 50 plants.

Figure 56. Distribution of *Cleome lutea* in the Montana portion of Bighorn Canyon NRA



Management Comments

Current population data are needed from the study area before making management recommendations. This species is likely to be affected by competition from weedy annuals, including halogeton.

Delphinium geyeri Greene Geyer’s larkspur Ranunculaceae (Buttercup Family)

Status

Heritage Rank: Global Rank G5; Montana - SU; Wyoming - S4 (not tracked).

Legal Status: USF&WS Status - None. BLM Status - None. USFS Status - None.

Description

Description: Geyer’s larkspur is a perennial 30-60 cm tall arising from deep, branched, fibrous roots. Leaves are basal and cauline, with dense, minute pubescence, and palmately divided with more rounded, wider lobes on basal leaves than stem leaves. Sepals are bright blue and flared, with spurs that are straight to slightly down-curved. Upper petals are whitish with blue tips, lacking prominent blue-purple lines (Warnock 1997).

Similar Species: Distinguished from *Delphinium bicolor* by the presence of dense, minute pubescence; also distinguished from *D. bicolor* ssp. *calcicola* by the cleft in the lower petal being 2 mm or less.

Flowering/Fruiting Period: The 1967 specimen from the Dryhead area was collected on 24 June; presumably in late flower or fruit.

Figure 57. Montana and Wyoming county distribution of *Delphinium geyeri*

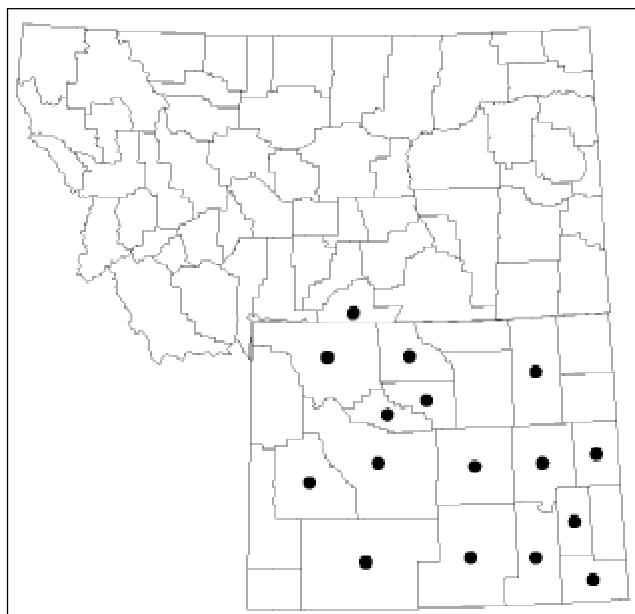
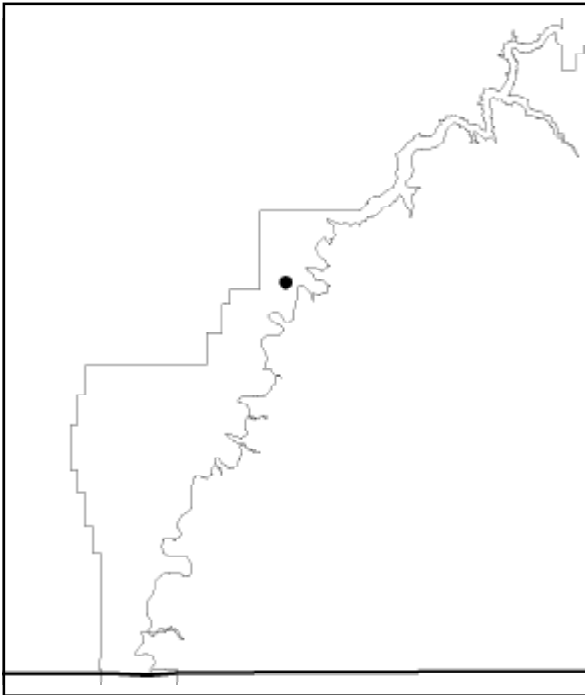


Figure 58. Distribution of *Delphinium geyeri* in the Montana portion of Bighorn Canyon NRA



Range and Habitat

Delphinium geyeri is a regional endemic species that has its center of distribution in Wyoming, extending into Colorado and Utah (Warnock 1997). Verification of specimens is needed to confirm that this species is in Montana. It is also possible that the specimens correspond with a newly-described variety of larkspur, *D. bicolor* ssp. *calcicola*. The state rank of *Delphinium geyeri* is undetermined until such time as specimens are verified. The only collection in or near the study area was “5 miles southeast of Dryhead near Bighorn River”.

Abundance

Unknown.

Management Recommendations

Study area data are needed before making management recommendations. The species is poisonous to livestock and is often an increaser under grazing. This species may be in a portion of the study area that is in grazing allotment.

Eupatorium maculatum var *bruneri*

(Gray) Breitung

Joe-pye weed

Asteraceae (Aster Family)

Status

Heritage Rank: Global Rank - G5TU; Montana - S2; Wyoming - S2 (not tracked)

Note: This species has been reranked in Montana from S1 based on results of this study.

Legal Status: USF&WS Status - None. BLM Status (MT) - Watch. USFS Status - None.

Description

Description: Joe-pye weed is a stout, fibrous-rooted perennial 60-150 cm tall. The lance-shaped leaves are 6-20 cm long, have serrated edges, and occur in whorls of 3-4 on the stem (Figure 58). Foliage is covered with short, curled hairs. Flowerheads are

Figure 59. Illustration of *Eupatorium maculatum* var. *bruneri*



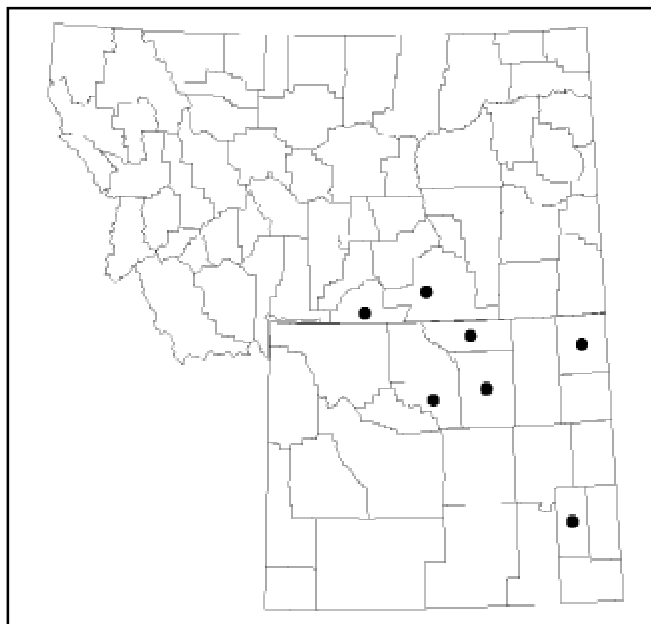
Illustration by John H. Rumely from “Vascular Plants of the Pacific Northwest”

arranged in a flat-topped, umbrella-like inflorescence at the top of the stem. Each head has 2-3 series of a few overlapping, purplish involucre bracts and 9-22 purple disk flowers. Ray flowers are lacking. The seeds have numerous, thin, stiff pappus bristles (Great Plains Flora Association 1986, Cronquist 1955.)

Similar Species: The combination of large size, whorled leaves, and purple, discoid flower heads distinguish this species from all other composites. *Eupatorium occidentale* (syn. *Ageratina occidentalis*) is put in the same genus by some authors, but has alternate leaves. The two other varieties of this species do not occur in the northern Rocky Mountain states.

Flowering/Fruiting Period: Flowering in August.

Figure 60. Montana and Wyoming county distribution of *Eupatorium maculatum* var. *bruneri*

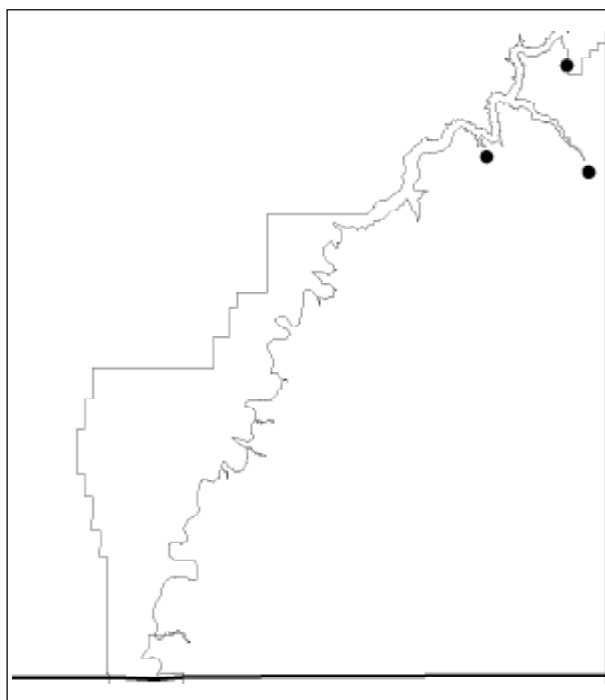


Range and Habitat

Joe-pye weed is common in eastern North America, extending from Newfoundland to North Carolina, and sporadically west from British Columbia and Montana south to Kansas and New Mexico. In Montana, it is restricted to the Bighorn and Tongue River drainages where it grows in moist meadows, springs, margins of spring-fed streams, and swamp thickets. In the Great Plains, it is considered a facultative upland species (USDI Fish and Wildlife Service 1994). It is not an

invasive “weed” but does become established in ditches and fencerows elsewhere in parts of its range. The three Bighorn Canyon populations are along the extensive seep and stream complex above Box Canyon directly along the Om-ne-a Trail; and along the two largest coldwater creeks, Black Canyon Creek and East Cabin Creek. It is in partial shade to full sun, associated with *Populus acuminata*, *Acer negundo*, *Betula occidentalis*, and *Rudbeckia laciniata* on streams; and *Salix bebbiana*, *S. melanopsis*, and *Carex lanuginosa* on seeps.

Figure 61. Distribution of *Eupatorium maculatum* var. *bruneri* in the Montana portion of Bighorn Canyon NRA



Abundance

There are six occurrences of Joe-pye weed in Montana. Population numbers are higher in Bighorn Canyon than in other Montana populations, with at least two populations numbering 100+ individuals above Box Canyon and along East Cabin Creek. This tall, multi-stemmed plant is very conspicuous, with multiple flowering stems from a single base that might give an impression of a profusion of plants when only one is present.

Management Recommendations

Joe-pye weed is potentially affected by water develop-

ments, recreation developments, livestock grazing, and herbicide treatment. The well drilled to supply water to the Ok-a-Beh Marina may have reduced habitat available at one end of the Box Canyon population. It has limited potential habitat within NRA boundaries, and occurs in the vicinity of other rare riparian corridor species like *Sullivantia hapemanii* var. *hapemanii*.

***Grayia spinosa* (Hook.) Moq.**
Spiny hopsage
Chenopodiaceae (Goosefoot Family)

Status

Heritage Rank: Global Rank - G5; Montana - S2; Wyoming - S4 (not tracked)

Legal Status: USF&WS Status - None. BLM Status (MT) - Watch. USFS Status - None.

Figure 62. Illustration of *Grayia spinosa*



Illustration by Jeanne R. Janish
From "Vascular Plants of the Pacific Northwest"

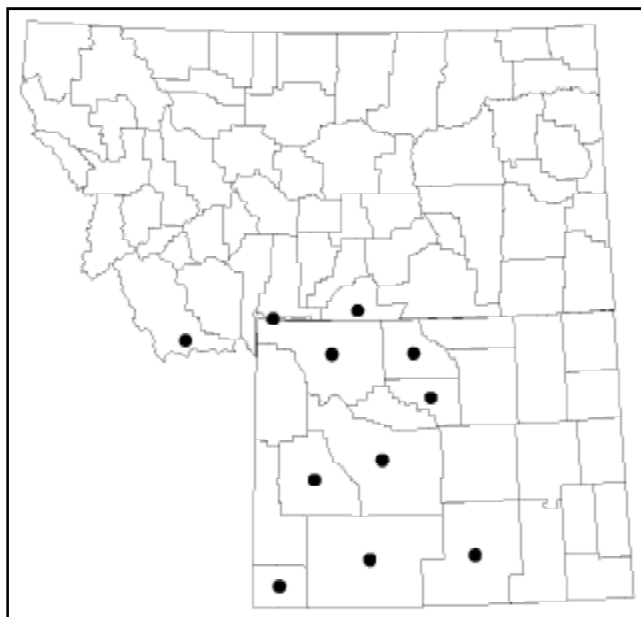
Description

Description: Spiny hopsage is a rounded, profusely branched shrub that is up to 1.5 m high and has erect or spreading, gray-barked, spine-tipped stems (Figure 61). The fleshy, broadly lance-shaped leaves are 10-25 mm long and have entire margins and a short stalk. Foliage is covered with small, star-shaped hairs that easily rub off. Male flowers are on different plants than female flowers. There are 2-5 small, green, sessile male flowers that are 1-2 mm long with a 4-lobed calyx, 4 stamens, and no petals; they occur in the axils of the smaller upper leaves, or bracts. Female flowers are arranged in small spikes in the upper leaf axils. Each flower has an ovary surrounded by 2 green, nearly circular bracts. When mature, the bracts enlarge to be 8-15 mm wide, and are whitish-green to red with thin margins (Hitchcock and Cronquist 1964).

Similar Species: The combination of fleshy leaves with circular, entire-margined, female fruiting bracts distinguishes this shrub from woody species of *Atriplex*. It superficially resembles the common *Atriplex confertifolia*, with which it is often associated.

Flowering/Fruiting Period: Flowering and fruiting in May-June.

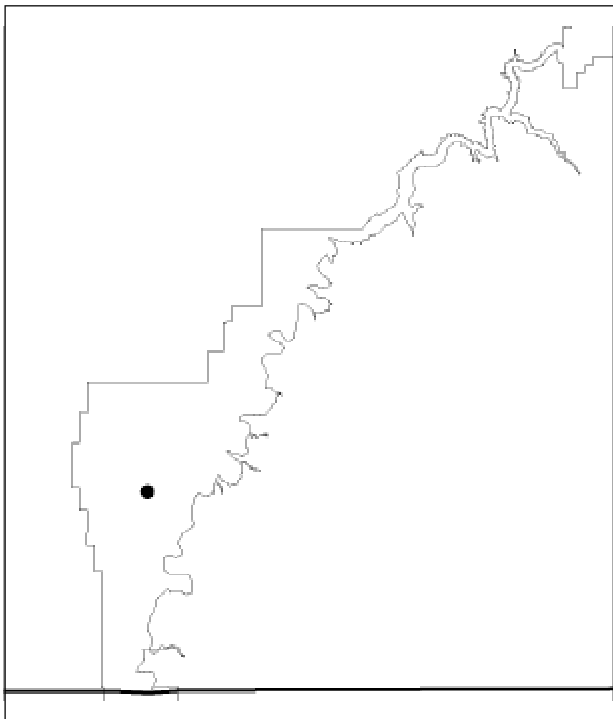
Figure 63. Montana and Wyoming county distribution of *Grayia spinosa*



Range and Habitat

Spiny hopsage is a Great Basin species distributed from eastern Washington to California, and eastward from Montana to Colorado. In Montana, it is known mainly from the Pryor Mountains desert, in addition to a historical record in Beaverhead County and a Park County occurrence outside of Gardiner in Yellowstone National Park. It occupies dry, alkaline, often sandy soils in desert shrubland of valleys dominated by *Artemisia tridentata* and variously codominated by *Stipa comata*, *Elymus spicatus*, *Bouteloua gracilis*, and *Atriplex confertifolia* (Lesica and Achuff 1992). It was collected in 1967 by W. E. Booth (#6740) and the location was characterized as “south of Dryhead community about 10 miles on flat overlooking the river.” This would seem to put it between Layout Creek and Devils Canyon overlook. It was not relocated in this study.

Figure 63. Distribution of *Grayia spinosa* in the Montana portion of Bighorn Canyon NRA



Abundance

Unknown.

Management Recommendations

Study area data is needed before making management recommendations.

Leptodactylon caespitosum Nutt.

Leptodactylon

Polemoniaceae (Phlox Family)

Status

Heritage Rank: Global Rank - G3G4; Montana - S2; Wyoming - S3 (not tracked).

Note: This species has been reranked in Montana from S1 based on results of this study.

Legal Status: USF&WS - None. BLM (MT) - Watch. USFS - None.

Description

Description: *Leptodactylon* is a mat-forming perennial with a highly branched woody rootcrown that gives rise to numerous mat-forming stems that are up to 2 cm high (Figure 64). Each stem is closely covered by opposite, deeply 2-3 equally-lobed, spine-tipped leaves that are 3-6 mm long. Foliage is glabrous to glandular. Solitary flowers are borne on the stem tips.

Figure 65. Illustration of *Leptodactylon caespitosum*

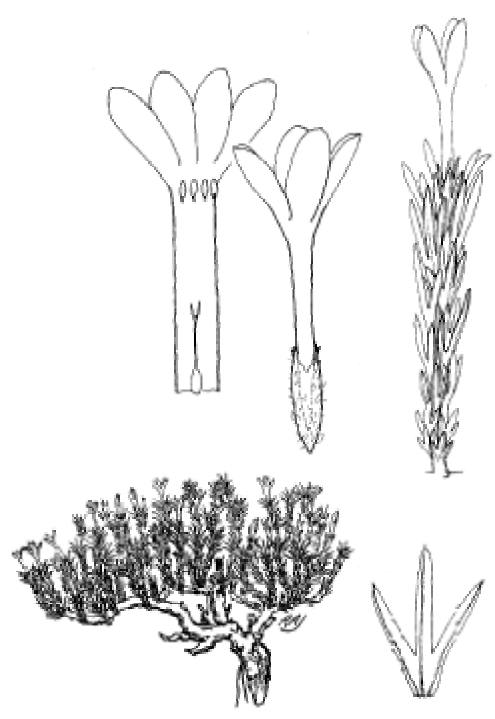


Illustration by Robin A. Jess
From "Intermountain Flora"

The pinkish-white, tubular corolla is 12-20 mm long and flares into 4 spreading lobes. 4 anthers are borne near the top of the tube, and the calyx is 5-8 mm long, with 4 shallow, pointed lobes. The fruit is a round capsule (Cronquist et al. 1984)

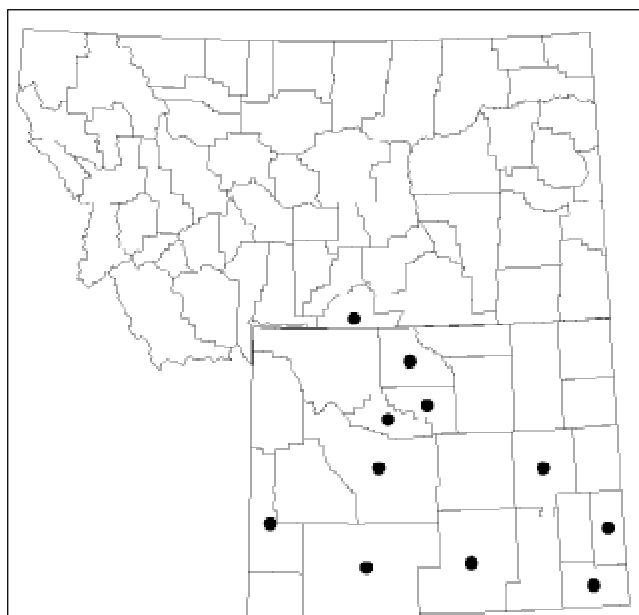
Similar species: *Leptodactylon pungens* is a taller subshrub and not forming tight mats or mounds. Both it and mat-forming species of *Phlox* have flowers with a 5-lobed calyx and corolla.

Flowering/Fruiting Period: Flowering in late May-early June.

Range and Habitat

Leptodactylon caespitosum is a Great Basin species of Utah, Nevada, Colorado and Wyoming that reaches as far east as western Nebraska and as far north as south-central Montana. It is restricted in Montana to the Pryor Mountains desert area of Carbon County. It is known from four Montana populations in the Bighorn Canyon NRA, but is more widespread in the Wyoming segment of the study area.

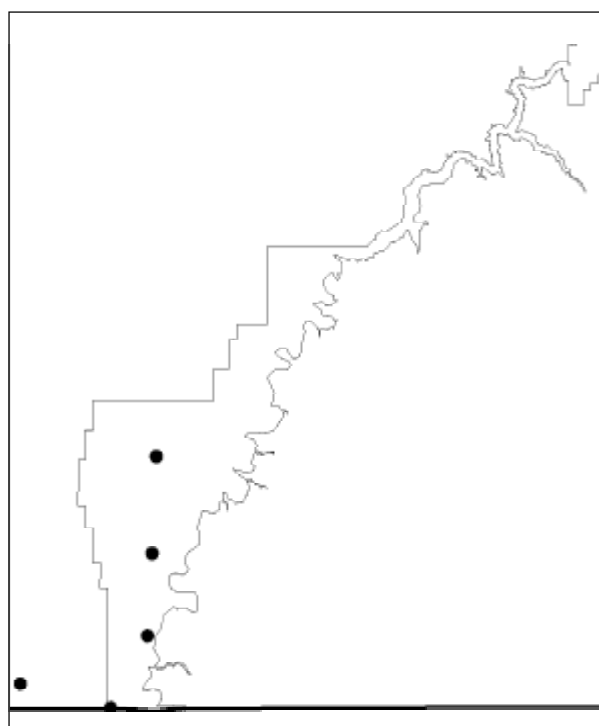
Figure 66. Montana and Wyoming county distribution of *Leptodactylon caespitosum*



This species occupies dry, rocky, windswept ridges mainly on the Chugwater Formation. It is most consistently found in association with sparsely-vegetated plant associations dominated by *Phlox*

bryoides, often co-dominated by *Chrysothamnus nauseosus*, but also with *Elymus spicatus* and *Juniperus osteosperma* (Lesica and Achuff 1992). In Bighorn Canyon, it is restricted to Chugwater Formation on barren slopes of deep red slate formed into knolls and ridges.

Figure 67. Distribution of *Leptodactylon caespitosum* within Bighorn Canyon NRA



Abundance

Populations are often locally abundant though highly restricted. There are two populations documented in Montana with over 1000 plants. Total estimated number of plants in Montana is over 5000 individuals. Of these, about 25% are in Bighorn Canyon NRA, where the two largest populations have over 500 individuals.

Management Recommendations

Road construction may have reduced some populations in the past, and right-of-way maintenance activities potentially affect the fringes of the largest population in Bighorn Canyon NRA. The harsh environment of this species is a deterrent to most exotic species invasion, but *Halogeton glomeratus* was observed invading roadside habitat close to one population. Livestock trail through part of the largest population in Bighorn Canyon NRA, bighorn sheep

and tourists congregate at the scenic overlook point of the other large population, and horse use is heavy at a third population. Despite these concentrated uses, there were no obvious signs of impact in the absence of any mechanical surface-disturbance.

***Mentzelia pumila* Nutt. ex Torr. & Gray**
var. *pumila*
Dwarf mentzelia
Loasaceae (Blazing-star Family)

Status

Heritage Rank: Global Rank - G4; Montana - S2;
Wyoming - S3 (not tracked)

Legal Status: USF&WS Status - None. BLM Status (MT) - Watch. USFS Status - None.

Description

Description: Dwarf mentzelia is a biennial or short-lived perennial with branched, white stems that arise from a stout taproot and that are 20-60 cm tall. The lance-shaped basal leaves are 8-10 cm long and have short petioles and broadly-toothed margins. The alternate leaves become sessile, smaller, and more deeply lobed higher on the stem. Foliage is covered with short, barbed hairs that cause it to stick to clothing like velcro. 1-3 flowers are borne on short stalks arising from the axils of the reduced upper leaves, or bracts. Flowers have 10 yellow petals that are 9-15 mm long and numerous stamens, the outer of which are petal-like. The calyx forms a deep bowl with 5 narrow, pointed lobes that are 4-10 mm long; it also contains the ovary and bears the stamens. The cylindrical seed capsules are 15-20 mm long.

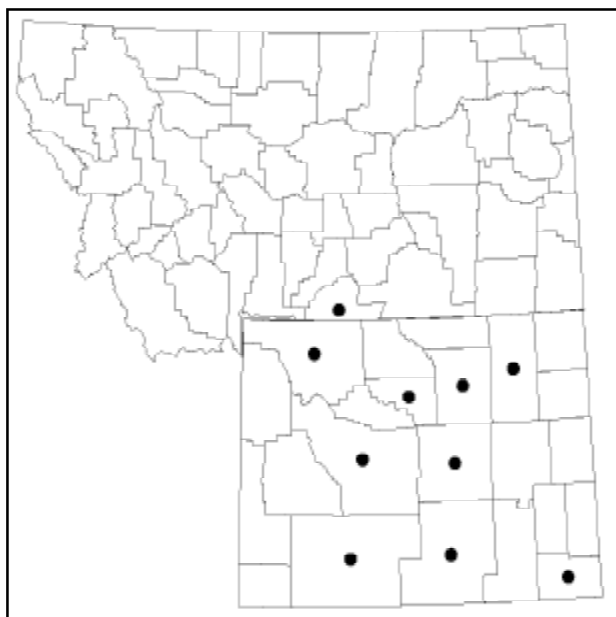
Similar Species: This is our only *Mentzelia* with 10 yellow petals and our only perennial member of the genus with calyx lobes less than 15 mm long (Dorn 1984, 1992).

Flowering/Fruiting Period: Flowering in June-early July.

Range and Habitat

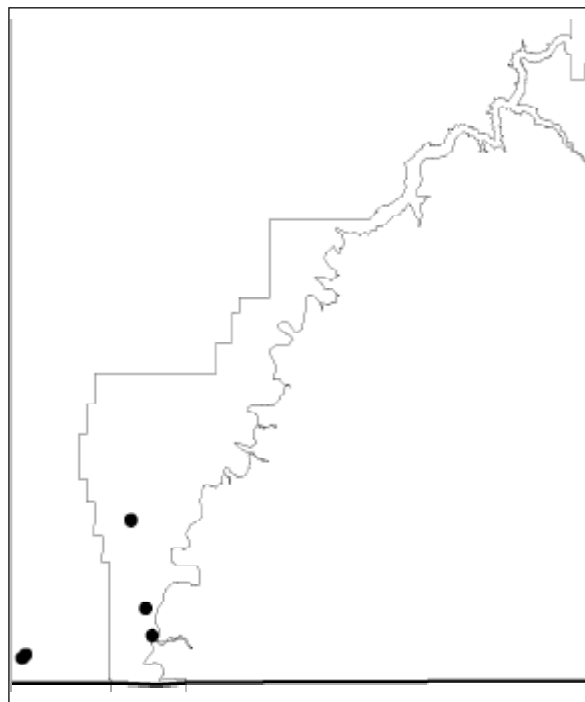
Dwarf mentzelia is a Great Basin species distributed from Colorado, Utah and Nevada as far north as

Figure 68. Montana and Wyoming county distribution of *Mentzelia pumila*



south-central Montana, where it is known only from the Pryor Mountains area in Carbon County. In the study area, it occurs on platy shale of the Chugwater Formation. It occupies open, usually sandy soil in sparse juniper woodlands and cushion plant communities dominated by *Elymus spicatus*, *Krascheninnikovia lanata* and *Phlox bryoides* (Lesica

Figure 69. Distribution of *Mentzelia pumila* in the Montana portion of Bighorn Canyon NRA



and Achuff 1992). In Montana, it was found at two sites and attempts to relocate a third were unsuccessful. There are at least three small populations on the Wyoming side on Sykes Mountain and the east shore of Yellowtail Reservoir.

Abundance

There are 16 occurrences in Montana, ranging in size from 1 plant to estimated numbers of 100-1000. Population numbers for this species are typically low, and it is subject to fluctuations in numbers. All populations found in the study area had fewer than 10 flowering plants. Immature basal rosettes were present but these could not be identified to species with certainty.

Management Recommendations

Most populations of Dwarf mentzelia are small and any surface disturbances that diminish or degrade suitable habitat are potential impacts. It was collected in 1982 near Devils Canyon Overlook by Larry Thompson and could not be relocated; precise location was not given and more extensive survey in June is needed before coming to the conclusion that this population is extirpated. One small Bighorn Canyon occurrence is reduced to an island of habitat surrounded by parking lot and park road. Despite the extremely harsh setting, exotic species such as *Halogeton glomeratus* are present in low numbers here and pose potential management concerns.

***Musineon vaginatum* Rydb.**
Sheathed musineon
Apiaceae (Parsley Family)

Status

Heritage Rank: Global Rank - G3G4; Montana - S3 (not tracked); Wyoming - S2 [Medium conservation priority]

Note: Global rank was changed from G3?, and Montana rank was assigned as S3 as a results of this study.

Legal Status: USF&WS Status - None; BLM Status - None; USFS Status - None.

Description

Description: Sheathed musineon is a perennial from a

stout taproot surmounting a short branched rootcrown, with 1-several slender stems that are 15-30 cm tall at maturity. The conspicuously sheathed leaves are basal and alternate on the stem, thrice-divided into linear segments. The inflorescence is a compound umbel of white or yellowish flowers, well-developed calyx teeth, and involucre bracts. The fruit is laterally compressed, with distinct ribs, 3-4 mm long (Hitchcock and Cronquist 1961).

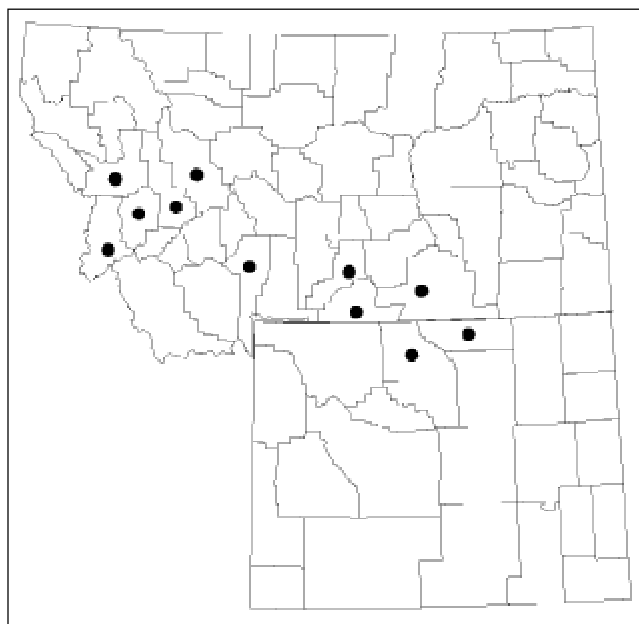
Similar Species: *Musineon divaricatum* has leaves subopposite and twice-divided, and none of the leaves have distinct stalks between the sheath and the base of the blade. Species of *Lomatium* differ in having the fruit dorsally compressed.

Flowering/Fruiting Period: Flowers from June-July; fruits produced from July-August.

Range and Habitat

Sheathed musineon is a regional endemic ranging from west-central Montana to north-central Wyoming, including Big Horn and Sheridan counties. While Montana represents the center of its limited range, it has never been considered a rare species in the state. It was only known from a total of about 20 collection stations in Montana in Big Horn, Carbon, Gallatin, Granite, Lewis & Clark, Missoula, Powell, and Stillwater counties. They include 18 collections representing about 15 different sites at MONTU and

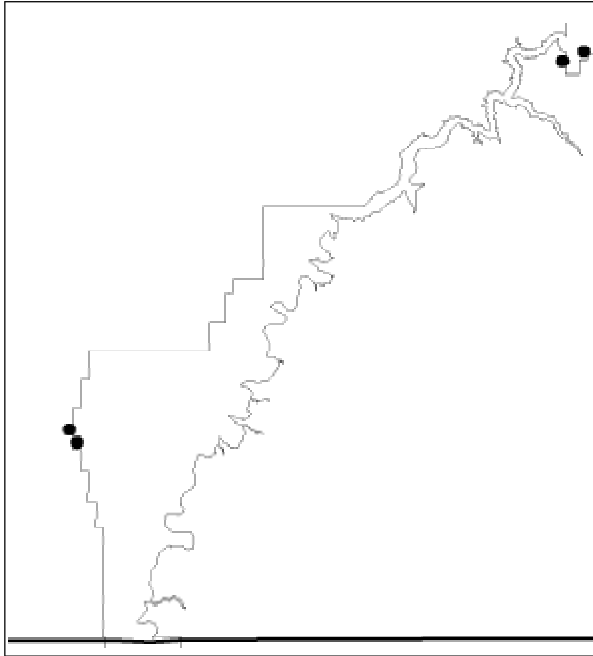
Figure 70. Montana and Wyoming county distribution of *Musineon vaginatum*



seven collection sites at Montana State University (MONT) representing six additional different sites.

In the study area, it was consistently found in

Figure 71. Distribution of *Musineon vaginatum* in the Montana portion of Bighorn Canyon NRA



Pseudotsuga menziesii stands, which are of limited extent in the NRA. It has not been found from the Wyoming part of the NRA. Vegetation plot data was examined for the adjoining Pryor Mountains, where it had been recorded in vegetation plots for most conifer woodland and forest plant associations (DeVelice and Lesica 1993) including:

Juniperus osteosperma – *Cercocarpus ledifolius*
Pinus flexilis/*Festuca idahoensis*
Pinus flexilis/*Juniperus communis*
Pseudotsuga menziesii/*Cercocarpus ledifolius*
Pseudotsuga menziesii/*Elymus spicatus*
Pseudotsuga menziesii/*Symphoricarpos oreophilus*

Substrates are derived from Madison Group limestones sometimes with loose rubble or fractured bedrock exposed at the surface, but more often with deep duff of undecayed needles.

Abundance

Sheathed musineon is not only widespread, it is very common throughout the more heavily forested types above. This ubiquity and abundance across the Pryor

Mountains-area landscape has not been documented elsewhere for the species.

Management Recommendations

No management needs were identified for Sheathed musineon. Populations in Montana are relatively secure and this species does not occur on the Wyoming side of the Bighorn Canyon NRA.

Oxytropis besseyi* (Rydb.) Blank. var. *fallax
Barneby
Bighorn locoweed
Fabaceae or Leguminosae (Pea Family)

Synonym: *Oxytropis nana* Nutt. var. *fallax* (Barneby) Isely

Status

Heritage Rank: Global Rank - G5T3; Montana - SU (watch); Wyoming - S3 (not tracked).

Note: Added to the watch list in Montana as having unresolved status, based on its recent documentation as an addition to the state flora.

Legal Status: USF&WS Status -None; BLM Status - none; USFS Status - None.

Description

Description: Bighorn locoweed is a stemless perennial forb from a stout rootstalk. Stems and leaves are densely silky-pubescent to nearly tomentose throughout with basally-attached hairs. The leaves are once-pinnately compound with 7-15 leaflets and are shorter than the flowering stalks. Flowers are pinkish-purple, 16-25 mm long, and are arranged in a loose, elongate inflorescence 2.5-5 cm long. The calyx tube is 6.5-8 mm long with linear or triangular teeth 2-2.5 mm long. Pubescence of the calyx is comprised of appressed or loosely ascending white hairs less than 1.5 mm long and does not obscure the calyx surface. Fruits are short-stalked, long-beaked, and woolly-pubescent and split the calyx at maturity (Barneby 1952; Dorn 1992; Isely 1998).

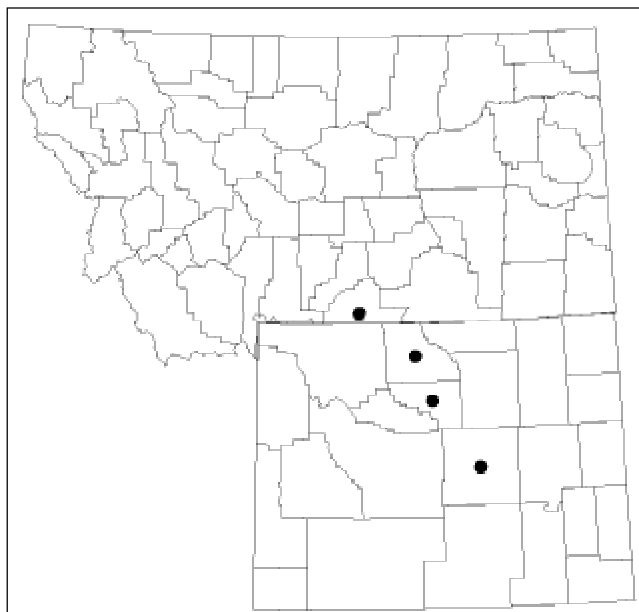
Similar Species: *Oxytropis besseyi* var. *obnapiformis* has sessile fruits, basal leaves that equal the inflorescence in length, and calyces with densely white-woolly hairs that obscure its surface. *O. besseyi* var. *ventosa* has a congested, head-like inflorescence and calyces with spreading or ascending hairs ca 2 mm long. *O. besseyi* var. *besseyi* has 9-21 leaflets per leaf and spreading to ascending hairs ca 2 mm long on the calyx. *O. nana* has a densely white-woolly calyx that is inflated (and not split) at maturity. *O. lagopus* has a mix of black and white hairs on the calyx. *O. lambertii* has herbage with t-shaped (dolabriform) hairs.

Flowering/Fruiting Period: Flowering occurs from late May to mid July. Fruits are present from early June to late July.

Range and Habitat

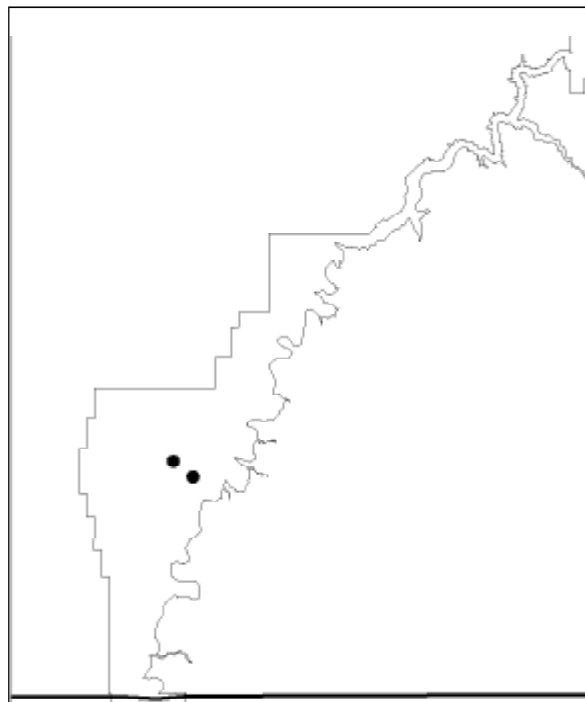
Bighorn locoweed is a regional endemic of the Bighorn and possibly Pryor Mountains and their foothills in Carbon County, Montana, and Big Horn, Fremont, Hot Springs, Natrona, and Washakie counties, Wyoming. It has only recently been recognized as present in Montana (Isely 1998) based on its documentation in Bighorn Canyon by Wyoming botanists in 1991 (Struttman and Fertig #54). It has not been systematically searched on the Montana side of the NRA, and may warrant further documentation.

Figure 72. Montana and Wyoming county distribution of *Oxytropis besseyi* var. *fallax*



O. besseyi var. *fallax* occurs on rocky sandy slopes, alluvial fans, gravelly sandstones, and eroded badlands from 3660-6600 feet. Populations may occur in sparsely vegetated cushion plant communities, *Artemisia tridentata*-*Stipa comata* grasslands, or *Juniperus osteosperma*-*Artemisia tridentata* shrublands.

Figure 73. Distribution of *Oxytropis besseyi* var. *fallax* in the Montana portion of Bighorn Canyon NRA



In Bighorn Canyon NRA, *O. besseyi* var. *fallax* is commonly found on terraces of red clay covered by dolomite rubble in cushion plant or sparse sagebrush grasslands with *Eriogonum brevicaulis* var. *canum*, *Haplopappus nuttallii*, *Arenaria hookeri*, *Hymenoxys acaulis*, *Cryptantha cana*, *Astragalus hyalinus*, *Lesquerella arenosa*, *Elymus spicatus*, *Stipa comata*, *Gutierrezia sarothrae*, and *Artemisia tridentata* var. *wyomingensis*. It is most commonly found on outcrops of Chugwater redbeds and Goose Egg sand and siltstones.

Abundance

This taxon is widely distributed at low population densities throughout much of the Bighorn Canyon NRA in Wyoming, and is locally abundant (although typically scattered) along much of the west slope of the Bighorn Range in north-central Wyoming.

Management Recommendations

No immediate management needs have been identified for Bighorn locoweed. Populations in Wyoming appear sufficiently secure so that this species is not a high priority target for conservation attention in that state, and status information in Montana is preliminary. Nature Conservancy's Tensleep Preserve and additional populations are likely to occur in BLM ACECs, potential Forest Service Research Natural Areas and Wilderness Study Areas along the western foothills of the Bighorn Range.

***Oxytropis besseyi* (Rydb.) Blank. var. *ventosa* (Greene) Barneby** Wind River locoweed Fabaceae or Leguminosae (Pea Family)

Synonym: *Oxytropis nana* Nutt. var. *ventosa* (Greene) Isely

Status

Heritage Rank: Global Rank - G5T3; Montana - SU (watch); Wyoming - S3 (not tracked).

Note: Added to the watch list in Montana as having unresolved status, based on its recent documentation as an addition to the state flora.

Legal Status: USF&WS Status -None; BLM Status - None; USFS Status - None.

Description

Description: Wind River locoweed is a stemless perennial forb from a stout rootstalk. Herbage is densely silky-pubescent to nearly tomentose throughout with basally-attached hairs. The leaves are 3-7 cm long and once-pinnately compound with 5-9 (11) crowded leaflets 10-21 mm long. Flowering stalks are 3-9 (13) cm long and exceed the basal leaves. Flowers are pinkish-purple with banners 15-20 mm long and are arranged in a dense, head-like inflorescence 0.5-2 (3) cm long. The calyx is 9-10.5 mm long with linear teeth 3-4 mm long and is thinly to densely covered by white, loosely spreading hairs about 2 mm long. Fruits are short-stalked, long-beaked, and woolly-pubescent and split the calyx at maturity (Barneby 1952, 1989; Dorn 1992; Isley 1998).

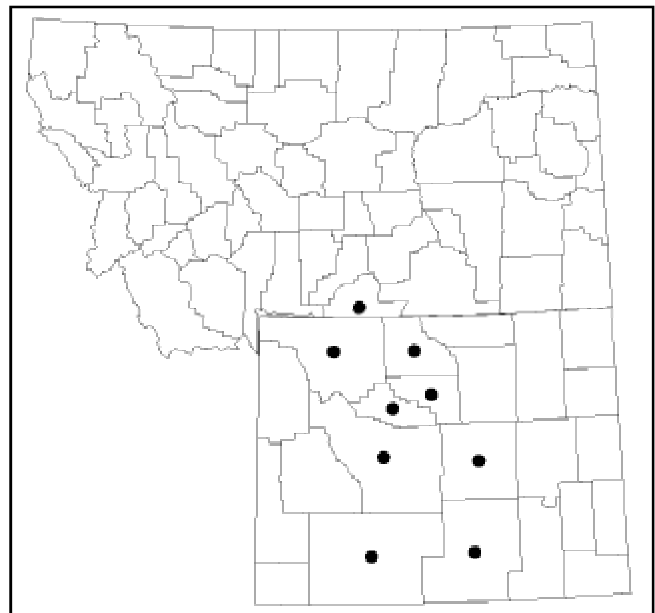
Similar Species: *Oxytropis besseyi* var. *besseyi* has a loose inflorescence that is 2-8 cm long at maturity and borne on a stalk 9-16 cm long and 9-21 leaflets per leaf. *O. besseyi* var. *fallax* has appressed hairs that are 1.5 mm long or less on the calyx. *O. lambertii* has herbage with t-shaped (dolabriform) hairs.

Flowering/Fruiting Period: Flowering occurs from late May to mid July. Fruits are present from early June to late July.

Range and Habitat

Wind River locoweed is a regional endemic of central

Figure 74. Montana and Wyoming county distribution of *Oxytropis besseyi* var. *ventosa*

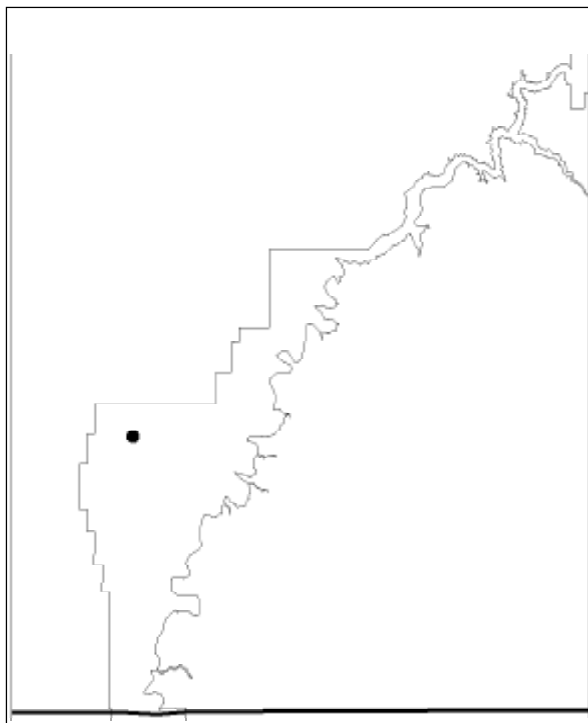


Wyoming (Big Horn, Carbon, Fremont, Hot Springs, Natrona, Park, Sweetwater, and Washakie counties), southcentral Montana (Carbon County), and northeastern Utah (Daggett County). Populations in Wyoming occur in the Bighorn, Wind River, Green River, and North Platte river basins and the foothills of the Absaroka Range. It has only recently been reported for Montana (Welsh 1998), and previous collection records of this taxon in the state are being secured to evaluate its status. It has not been systematically searched on the Montana side of the NRA, and may warrant further documentation.

Wind River locoweed is found primarily on arid sandstone and siltstone ridges in cushion plant or sparsely vegetated sagebrush grasslands. Populations are also occasionally found on sandy beaches, badlands, and dry volcanic slopes. In Wyoming, it ranges in elevation from 4600-8300 feet.

Abundance

Figure 75. Distribution of *Oxytropis besseyi* var. *ventosa* in the Montana portion of Bighorn Canyon NRA



O. besseyi var. *ventosa* is known from over 50 locations in central Wyoming. No formal surveys have been conducted to determine its abundance in the state.

Management Recommendations

No immediate management needs have been identified for Wind River locoweed. Populations in Wyoming appear sufficiently secure so that this species is not a high priority target for conservation attention in that state, and status information in Montana is preliminary.

Senecio eremophilus Richardson var. *eremophilus*

Cut-leaved groundsel

Asteraceae or Compositae (Aster Family)

Status

Heritage Rank: Global Rank - G5T5; Montana - S1; Wyoming - S3 (not tracked)

Legal Status: USF&WS Status - None. BLM Status - None. USFS Status - None.

Description

Description: Cut-leaved groundsel is a short-lived, glabrous perennial with a solitary stem that is 30-120 cm high and arising from a short taproot (Figure 74). The lowest leaves are inconspicuous, while the others are alternate and little reduced upwards. Each leaf has

Figure 76. Illustration of *Senecio eremophilus* var. *eremophilus*



Illustration by John H. Rumely
From "Vascular Plants of the Pacific Northwest"

a short petiole and a lance-shaped blade that is 4-15 cm long with deeply lobed and coarsely-toothed margins. Numerous flower heads are borne in an open, flat-topped, terminal inflorescence. The heads have a single series of ca. 13 non-overlapping, narrow, pointed, minutely black-tipped involucre bracts that are 7-9 mm long. The ca. 40 disk flowers are yellow, and the ca. 8 yellow rays are 6-10 mm long. The achene has a pappus of white bristles at its summit (Cronquist 1955).

Similar Species: Distinguished from other tall, leafy-stemmed *Senecio* by having lobed, coarsely toothed leaves, and a taproot rather than fibrous roots. The two other varieties of this species do not occur in the northern Rocky Mountain States.

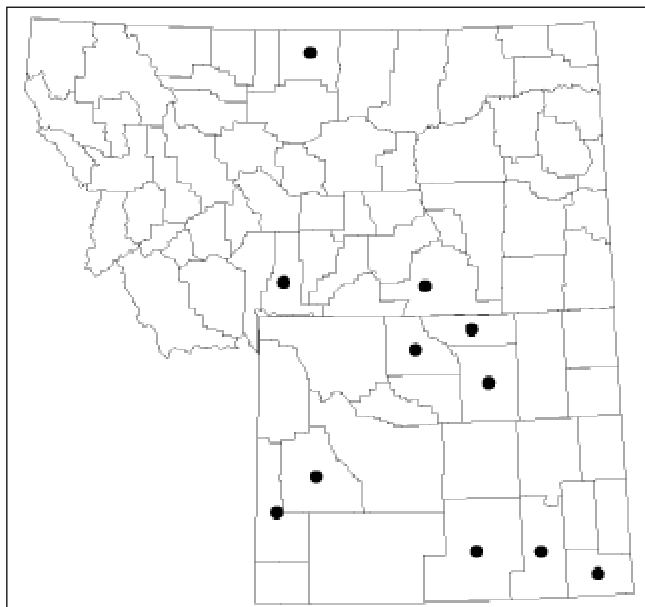
Flowering/Fruiting Period: Flowering in late June.

Range and Habitat

Cut-leaved groundsel is a western species distributed from British Columbia to Ontario, and south from Arizona and New Mexico to Nebraska. In Montana, it is known from the Bear's Paw Mountains, Bighorn Canyon, and historically from the Yellowstone Valley.

It is considered to be a facultative wetland species in the Great Plains (USDI Fish and Wildlife Service 1994). Its habitat includes moist streambanks and riparian forests in the valley and montane zones. It

Figure 77. Montana and Wyoming county distribution of *Senecio eremophilus* var. *erimophilus*

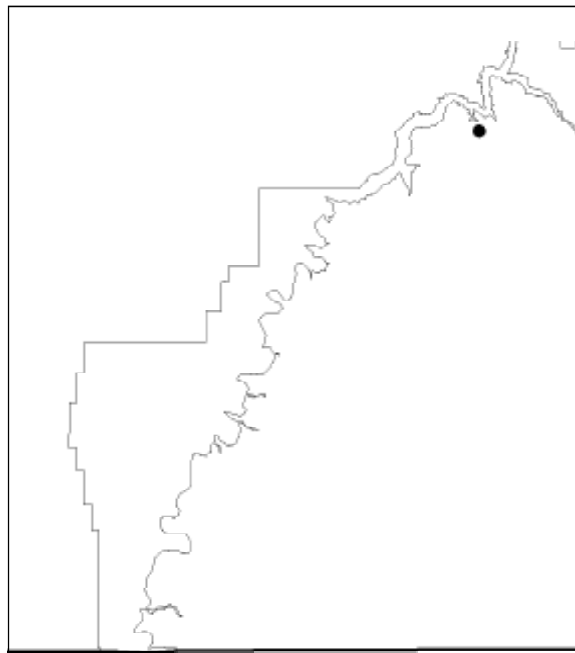


was originally collected in Bighorn Canyon from a streambank setting along East Cabin Creek by Lichvar (#6383) and was not relocated in this study.

Abundance

Unknown.

Figure 78. Distribution of *Senecio eremophilus* var. *eremophilus* in the Montana portion of Bighorn Canyon NRA



Management Recommendations

Study area data are needed before making management recommendations. Cut-leaved groundsel appears to be a riparian corridor species of perennial spring-fed streams, with limited potential habitat inside NRA boundaries.

***Sphenopholis intermedia* (Rydb.) Rydb.**
Slender wedgegrass
Poaceae (Grass Family)

Synonym: *Sphenopholis obtusata* var. *major*

Status

Heritage Rank: Global Rank - G5; Montana - S1;
Wyoming - S2 (not tracked).

Legal Status: USF&WS Status - None. BLM Status -
None. USFS Status - None.

Description

Description: Slender wedgegrass is an annual or short-lived perennial grass with stems 20-100 cm tall in small clusters and arising from fibrous roots (Figure 77). Leaves are flat, 2-5 mm wide, and minutely roughened. The slender spike is made up of loosely clustered spikelets that are on erect branches that are plainly distinct. Spikelets are two-flowered, and the seeds drop with the glumes. The shape and difference

in width of the two glumes is distinctive, with the large second glume being very broad at its upper end, giving it the appearance of a wedge. Lemmas are 2.5-3 mm (Great Plains Flora Association 1986).

Similar Species: Distinguished from the more common *Spheonopholis obtusata* by the relatively open inflorescence, second glume almost 3 times as long as wide, and pointed glume tips (Dorn 1992).

Flowering/Fruiting Period: Producing seed in late June-July.

Range and Habitat

Sphenopholis intermedia is a widespread northern plant extending from Alaska to Newfoundland and scattered southward as far as New Mexico. It is a facultative wetland species (USDI Fish & Wildlife Service 1993). In Montana, it is known from Big Horn County and a historic collection in Park County. The Big Horn collection information indicated that the material was collected in riparian habitat of East Cabin Creek.

Figure 79. Illustration of *Sphenopholis intermedia*

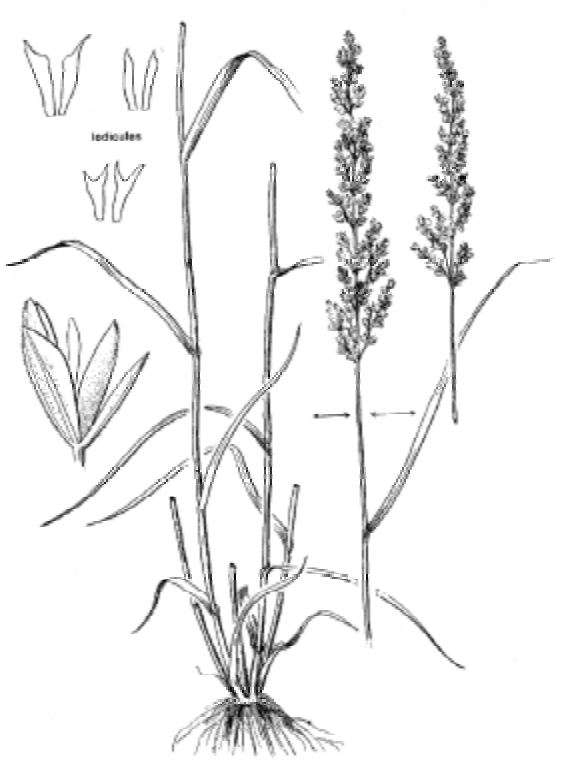
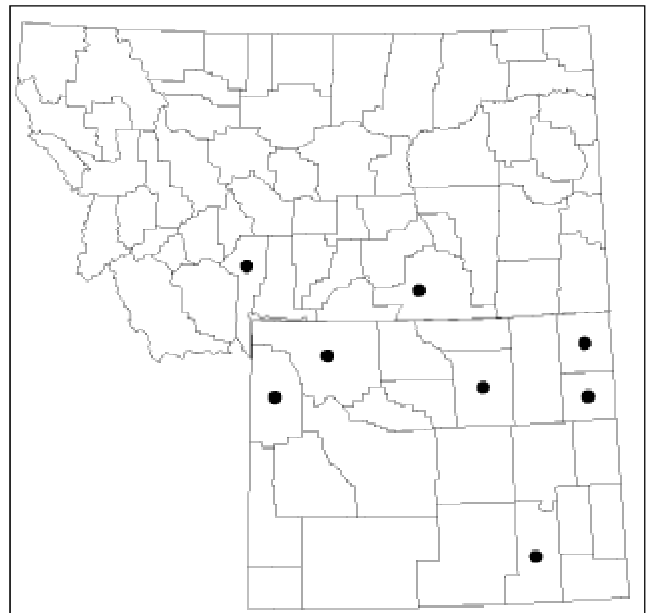


Illustration by Jeanne R. Janish
From "Vascular Plants of the Pacific Northwest"

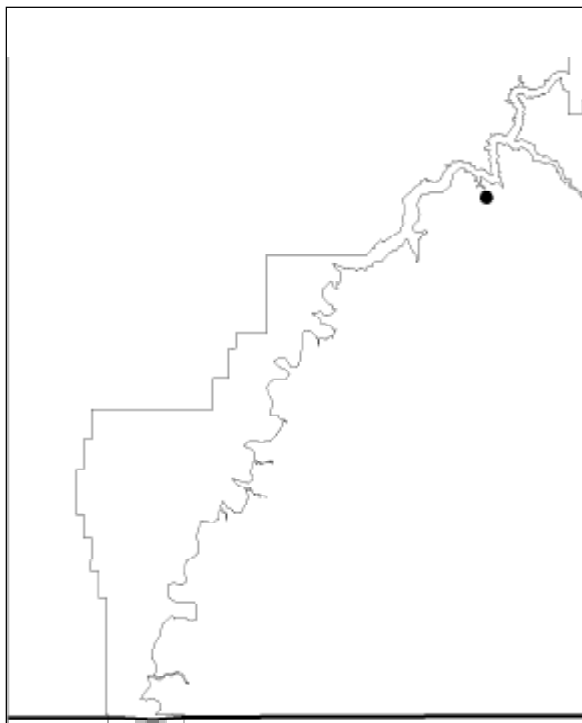
Figure 80. Montana and Wyoming county distribution of *Sphenopholis intermedia*



Abundance

Unknown.

Figure 81. Distribution of *Sphenopholis intermedia* in the Montana portion of Bighorn Canyon NRA



Management Recommendations

Study area data are needed before considering management of Slender wedgegrass. If it is a riparian species, then there is limited potential habitat inside NRA boundaries.

Stipa lettermanii Vasey Letterman's needlegrass Poaceae (Grass Family)

Status

Heritage Rank: Global Rank - G5; Montana - S1; Wyoming - S3S4 (not tracked)

Legal Status: USF&WS Status - None. BLM Status - None. USFS Status - None.

Description

Description: Letterman's needlegrass is a bunch-forming perennial with mostly glabrous stems that are 20-60 cm tall (Figure 80). The leaf blades are 1-1.5

Figure 82. Illustration of *Stipa lettermanii*

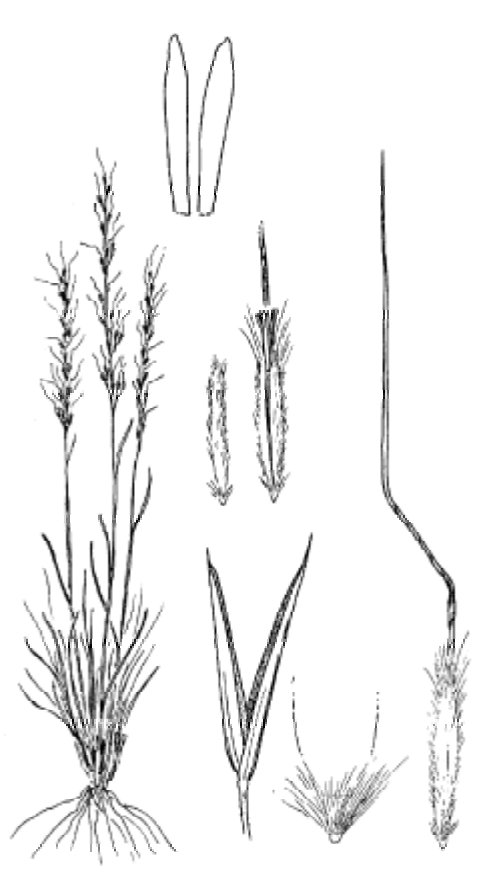


Illustration by Jeanne R. Janish
From "Vascular Plants of the Pacific Northwest"

mm wide and are threadlike or inrolled. Ligules are membranous, mostly 0.3 to 0.8 mm long, and with a straight margin. The narrow inflorescence is 10-15 cm long with erect branches. The spikelets consist of two glumes that are longer than and enclose a single floret. The glumes are 6-9 mm long with 3 nerves and pointed tips. The lemma is hardened in comparison to the glumes, is hairy with longer hairs towards the tip, and has a twisted, bent, glabrous awn from its tip that is about 1.5 cm long; the body of the lemma, excluding the awn, is 4-5.5 mm long. The palea is hairy, about 3.5 mm long, and usually at least 2/3 the length of the body of the lemma (Hitchcock et al. 1969).

Similar Species: Distinguished from other species of *Stipa* in Montana by having short, glabrous awns and paleas that are hairy and about 2/3 the length of the lemmas. A hand lens and technical key may be needed for positive identification (Dorn 1984).

Flowering/Fruiting Period: Fruiting in late June-July.

Range and Habitat

Stipa lettermanii is a western Basin species distributed from Oregon and California east to Montana and New Mexico. In Montana, it is known only from Bighorn Canyon, the upper Madison River drainage, and a recent addition in the Centennial Valley. In these settings it was reported on limestone talus and dry fescue grassland in the valley and foothill zones.

Figure 83. Montana and Wyoming county distribution of *Stipa lettermanii*

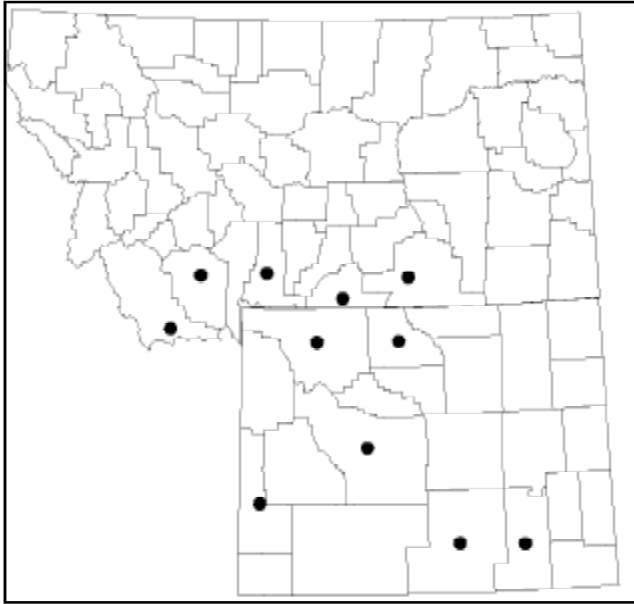
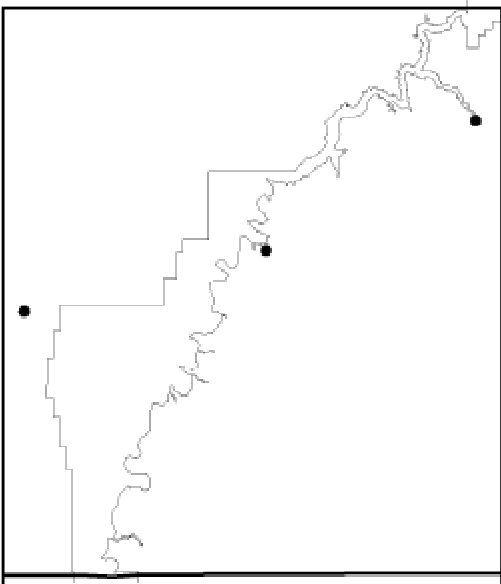


Figure 84. Distribution of *Stipa lettermanii* in the Montana portion of Bighorn Canyon NRA



Abundance

Unknown. Its local distribution spans the range of elevation in the NRA from canyon bottom to the Pryor Mountains rim, suggesting that documentation is incomplete.

Management Recommendations

Study area data are needed before making management recommendations. It is not known whether the two collections made in 1983 were at or near reservoir level.

Discussion and Management Recommendations

Bighorn Canyon NRA provides significant habitat for 25 globally rare or state rare plant species. More importantly, the NRA is one of the few areas within the Bighorn Basin or the west foothills of the Bighorn Range that is managed specifically for the enhancement of natural processes and biological diversity. Under current management, most species appear to be secure and have stable population sizes. Exotic species encroachment, recreational activities, water management, fire management, and wild horse use may affect three globally rare species. Effects of other management actions on these and other species are unresolved or small-scale.

Monitoring is needed to answer questions about population trends and to assess changes in species abundance or distribution in response to current practices or management change. This is most important for the globally restricted plants found in the Bighorn Canyon NRA potentially affected by management actions. We recommend implementing the following monitoring programs, described in greater detail in the preceding species summaries:

1. Combine monitoring of *Rorippa calycina* with *Tamarisk chinensis* control efforts on the east side of Yellowtail Reservoir in Wyoming. Record results in combination with water level data for further evaluation of water level management effects on *Rorippa calycina*.
2. Take photo points of two vulnerable *Sullivantia hapemanii* var. *hapemanii* populations (Box Canyon, Trail Creek), and determine if there are earlier photos, to detect major changes in species' cover as indication of trend as affected by water levels and recreation, respectively.
3. Monitor wild horse grazing effects on demography of *Stanleya tomentosa* var. *tomentosa*. Also monitor fire effects if occurrences are within prescribed burn plans.

In addition, we recommend the following general actions:

1. Control noxious weeds
2. Evaluate the effects of management actions on the five globally rare species
3. Identify the most vulnerable habitats of globally rare species as places of special management concern
4. Pursue remaining plant and plant community inventory needs

Each of these four general actions is discussed in greater detail under the headings that follow.

1. Control noxious weeds

One of the most widespread threats to rare species conservation and native species in much of Montana and Wyoming is invasion by exotic species (Sheley and Petroff 1999, Schassberger and Achuff 1991). With the exception of Saltcedar (*Tamarisk chinensis*) and its effects on *Rorippa calycina*, noxious weeds are not well-established in the Bighorn Canyon NRA and are not yet significantly impacting rare plants. The opportunity to curtail or curb noxious weed encroachment is important to long-term rare species conservation in the NRA. The following discussion highlights the exotic species that were mentioned in Knight et al. (1987) and that are recognized as noxious species in one or both states, plus other exotic species that pose potential management problems or management questions.

Saltcedar (*Tamarisk chinensis*) is widespread along the drawdown zones and mudflats at the south end of the Reservoir, becoming established throughout the growing season in bands, and building up seedbanks that greatly confound control. Hudson's (1999) baseline research on Saltcedar would ideally be meshed with *Rorippa calycina* species' monitoring at the south end of the NRA to contribute to Reservoir water level management reviews and guidelines. Saltcedar is abundant upstream on the Bighorn and Shoshone Rivers and is at early stages of becoming established upstream on side tributaries along Davis Creek, East Cabin Creek area, and Trail Creek where there are no other immediate threats to these coldwater stream systems and their rare species.

Russian and Spotted knapweed (*Centaurea repens* and *Centaurea maculosa*, respectively) and Leafy spurge (*Euphorbia esula*) are among the most serious threats in Bighorn Canyon NRA and have the potential to invade the habitats of nearly all Bighorn Canyon rare species if left unchecked. They become established in a wide range of moisture conditions. They are most likely to initially invade at sites of heaviest traffic including campgrounds, fishing accesses, and roadsides. They could spread most readily into habitats of globally rare species from road right-of-ways that cross creeks or cushion plant communities. They can also spread readily, with much greater difficulty of control, along reservoir margins. While the options for shoreline control of these species may be more limited, they are all the more critical in the impoundment landscape.

Halogeton (*Halogeton glomeratus*) is a salt-accumulating species that is present in arid areas at the south end of the NRA. It thrives under heavy grazing but is most common in roadside settings of the study area. It is present in low numbers on barren habitat of two state rare plant species, *Leptodactylon caespitosum* and *Mentzelia pumila*, and is close to several other state rare species occurrences.

Canada thistle (*Cirsium arvense*), Hoary cress (*Cardaria draba*), and Field bindweed (*Convolvulus arvensis*) are mainly restricted to disturbed settings with limited potential to expand into intact vegetation. Canada Thistle, however, is abundant at the mouth of some spring-fed stream inlets in the Canyon, and is part of the competing vegetation crowding out native vegetation along stream margins that support Wyoming *Sullivantia* at the lowermost ends of streams. It was not otherwise noted as a threat to rare species.

Red fescue (*Festuca rubra*) and Northern reedgrass (*Phalaris arundinacea*), sometimes with other introduced haymeadow grasses including Smooth brome (*Bromus inermis*), Timothy (*Phleum pratense*) and Quackgrass (*Agropyron repens*), are present around most springs and seeps including most *Sullivantia hapemanii* var. *hapemanii* populations. It appears that only the springs and seeps that have had heavy disturbance also have these species in abundance, but this does not preclude the possibilities of invasion and expansion under current management.

Annual bromes, particularly Cheatgrass (*Bromus tectorum*) are widespread (Knight et al. 1987) and have been reported to have allelopathic effects on germination of native species. It is also reported to foster increased fire frequency. There are related questions whether fire fosters the invasion of Cheatgrass. Heidel observed a lightning strike in July 1998, and the site was visited on the ground in 1999. The fire killed *Pinus flexilis* and *Elymus spicatus*, resulting in a solid *Bromus tectorum* stand. This is consistent with studies that report explosive numbers of annual bromes in burned grassland habitat of northeastern Wyoming (Williams 1961, 1963).

In a few of our inventory sites, native species that increase under disturbance are locally common. Purple threeawn (*Aristida purpurea*) is native but its relative abundance may indicate grazing pressure. One of the “windswept plateau” plots of Knight et al. (1987) showed relatively high frequency for this species.

2. Evaluate the effects of management actions on the five globally rare species

Riparian zone management on the Yellowtail Reservoir includes both “confined” and “unconfined” reservoir segments, and competition between a rare plant species (*Rorippa calycina*) vs. an exotic species (*Tamarix chinensis*) for shoreline habitat. Water levels reached maximum-allowed pool elevations of 3,650 ft. in late July of 1999. The mid-summer peak, at least in years of high water conditions, may interfere with *Rorippa calycina* flowering and seed establishment if not competitive ability and survival. Reservoir water levels may still be affecting the *Sullivantia hapemanii* var. *hapemanii* population in Box Canyon, or all of the alteration may already have taken place.

Wildfire policy and prescribed burn planning are important in rare species conservation. Wildfire policy potentially affects the Layout Creek headwaters and Sykes Ridge rare species, considering the high numbers of standing dead trees among the Douglas fir stands in this area. Species potentially involved include *Lesquerella lesicii* and *Astragalus aretioides*, plus adjoining populations of *Shoshonea pulvinata* that are outside the study area. These settings are on the western NRA boundary and management will require coordination with BLM.

Wildlife and wild horse management planning are similarly important to rare plant populations. The viability of *Stanleya tomentosa* var. *tomentosa* under wild horse grazing may warrant monitoring. The “natural state” of *Astragalus geyeri* var. *geyeri* habitat is an unresolved question for this species that is present in one small area with heavy wild horse use. Three of the six globally rare species are present in low numbers in Dyyhead livestock allotments where habitat is limited for them. Trailing and yarding elsewhere in the NRA may have localized affects, or provide opportunity to evaluate grazing responses on a small scale.

3. Identify the most vulnerable habitats of globally rare species as places of special management concern

Within existing management zones and subzones, it may be desirable to identify the most vulnerable plant communities that are critical to associated globally rare species, and document/map them further. Spring-seep systems are very restricted on the landscape, and very fragile and vulnerable to any foot traffic or altered hydrology. In such an arid landscape, the waters of springs and spring-fed streamcourses have historically been centers of use and development, as with the fish hatchery development at Sykes Spring immediately west of Bighorn Canyon NRA. The most fragile habitats in the study area are the intact springs that are dominated by *Sullivantia hapemanii* var. *hapemani*. These are found in “amphitheater” settings and other major spring-seep systems, where an emergent wetland association is fed by groundwater high in calcium carbonate, on both bedrock and colluvial substrate.

This species is also present along streams at the northern end of the study area but does not form a discrete community in these settings, nor are the streamside settings as vulnerable. Graminoid seeps form another type of seep wetland, with varying abundance of *Carex lanuginosa*, *Juncus torreyi*, *Carex praegracilis*, *Carex aquatilis*, *Dichanthelium acuminatum* var. *lanuginosa*, *Muhlenbergia richardsonis*, *Scirpus pungens* and *Eleocharis pauciflora*. They adjoin *Eupatorium maculatum* var. *bruneri* habitat in the Box Canyon area, and are potential habitat for other state rare plants but are not known to harbor globally rare plants. At the other ecological extreme are the cushion plant

communities, called windswept plateaus in Knight et al. (1987), and *Elymus spicatus*/Cushion Plant Herbaceous Vegetation in DeVelice and Lesica (1993). The cushion plant community occurs on windswept plateaus, ridges, and upper slopes of foothills and outwash plains around the Pryor Mountains and Bighorn Mountains. In the Pryor Mountains Desert, the soils have been characterized as deep soils from limestone or calcareous sandstone (DeVelice and Lesica 1993), but in the study area they also include thin-soil sites with gravel pavement over bedrock. *Elymus spicatus* is consistently present with the highest cover among grass species. Total vegetation cover is low and most of the rest of vegetation canopy cover is made up of cushion-forming perennial forbs with 1-7% species cover, including *Arenaria hookeri*, *Hymenoxys acaulis*, *Phlox bryoides*, and *P. hoodii* (Knight et al. 1987, DeVelice and Lesica 1993). These may be found in different combinations and patterns. One distinct form has *Sphaeromeria capitata* as the dominant cushion plant species, as found in the most exposed settings between Crooked Creek and Booz Hill. *Erigeron allocotus* is consistently found in or adjoining these settings in relatively high numbers, and is most vulnerable here. A number of other locally common regional endemics are restricted to the cushion plant community or reach their peak numbers here, including *Townsendia spathulata* and *Penstemon laricifolius*. Despite the harshness of the setting and the ruggedness of the community, it has some of the most restricted flora and may be vulnerable to concentrated trampling and degradation.

4. Pursue remaining plant species and plant community inventory needs

We recommend inventorying concentrations of state rare species, and species groups that were not inventoried such as nonvascular plants. We also recommend expanded survey and documentation of vulnerable habitats, and possible floristic work in select areas. These are encapsulated in the following:

1. Riparian corridors of coldwater streams at the far north end
2. Cushion plant communities
3. Marsh and forest riparian habitat at the far south end of Yellowtail Reservoir
4. Cliff habitat and large segments of dryland canyon habitats
5. Vernal flora in outwash settings
6. Graminoid seep wetland habitats.

Conclusions

Bighorn Canyon NRA is important to the long-term viability of four globally rare plant species that are endemic to the Bighorn Basin or Bighorn and Pryor Mountains areas. We documented and analyzed the distribution, relative abundance, and habitat of these species in the study area and reviewed rangewide information to determine that they are vulnerable but not imperiled. They include:

- Bighorn fleabance (*Erigeron allocotus*; global rank: G3)
- Persistent-sepal yellowcress (*Rorippa calycina*; global rank: G3)
- Hairy prince's-plume (*Stanleya tomentosa* var. *tomentosa*; global rank: G3T3).
- Wyoming Sullivantia (*Sullivantia hapemanii* var. *hapemanii*; global rank: G3T3)

Bighorn Canyon NRA is among the few areas for the first three of these species that is managed for natural processes and biological diversity. Monitoring of species' population trend or species' management response is needed for the latter three species to provide a management framework.

Bighorn Canyon NRA has secondary importance for Lesica's bladderpod (*Lesquerella lesicii*; global rank: G1) among a suite of globally and state rare plants requiring interagency coordination along part of the western border of the NRA. In general, it appears to have high importance in providing habitat for state species of special concern as indicated by the numbers of tracked and watch species in the Montana segment of the study area, warranting further evaluation.

These data are conveyed to help resource managers develop and prioritize management and monitoring plans to ensure the long-term viability of globally rare plant species, and protect the most important concentrations and habitats of both globally and state rare plant species.

Literature Cited

- Alt, D. and D. W. Hyndman. 1986. Roadside geology of Montana. Mountain Press Publishing Company, Missoula, MT.
- Bailey, R. G., P. E. Avers, T. King, and W. H. McNab. 1994. Ecoregions and subregions of the United States. USDA Forest Service. 1:7,500,000 map.
- Barneby, R. C. 1952. A revision of the North American species of *Oxytropis* DC. Proceedings of the California Academy of Sciences IV. 27:177-312.
- Barneby, R. C. 1964. Atlas of North American *Astragalus*. Memoirs of the New York Botanical Garden, 13:1-1188.
- Barneby, R. C. 1989. Volume 3, Part B, Fabales. In: A. Cronquist, A. H. Holmgren, N. H. Holmgren, J. L. Reveal, and P. K. Holmgren, eds. Intermountain Flora, Vascular Plants of the Intermountain West, USA. New York Botanical Garden, Bronx, NY.
- Blake, S. F. 1937. New Asteraceae. Journal Washington Acad. Sciences. 27:379-380.
- Clark, T. W. and R. D. Dorn, eds. 1979. Rare and Endangered Vascular Plants and Vertebrates of Wyoming. Publ. by the editors, Jackson, WY.
- Cronquist, A. 1947. Revision of the North American species of *Erigeron*, north of Mexico. Brittonia 6(2):121-300.
- Cronquist, A. 1955. Pt. 5. Compositae. In: C. L. Hitchcock, A. Cronquist, M. Ownbey and J. W. Thompson, eds. Vascular Plants of the Pacific Northwest. University of Washington Press, Seattle.
- Cronquist, A., A. H. Holmgren, N. H. Holmgren, J. L. Reveal and P.K. Holmgren, eds. 1984. Vol. 4, Subclass Asteridae (Except Asteraceae). In: Intermountain Flora, Vascular Plants of the Intermountain West, USA. New York Botanical Garden, Bronx, NY.
- Cronquist, A. 1994. Vol.5, Asteraceae. In: A. Cronquist, N. H. Holmgren, J. Holmgren, J. Reveal, and P. K. Holmgren, eds. Intermountain Flora, Vascular Plants of the Intermountain West, USA. New York Botanical Garden, Bronx, NY.
- DeVelice, R. and P. Lesica. 1993. Plant community classification for vegetation on BLM lands, Pryor Mountains, Carbon County, Montana. Unpublished report to the Bureau of Land Management. Montana Natural Heritage Program, Helena.
- Dorn, R. D. 1984. Vascular Plants of Montana. Mountain West Publ., Cheyenne, WY.
- Dorn, R. D. 1992. Vascular Plants of Wyoming, second edition. Mountain West Publ., Cheyenne.
- Fertig, W. 1993. Field survey for *Cleome multicaulis*, *Cymopterus williamsii*, and *Sullivantia hapemanii* in north-central Wyoming. Unpublished report prepared for the Casper District of the Bureau of Land Management by the Wyoming Natural Diversity Database, Laramie.
- Fertig, W. 1999. The status of rare plants in the Bighorn Landscape. Report prepared for The Nature Conservancy Wyoming State Office by the Wyoming Natural Diversity Database, Laramie, WY.
- Fertig, W. and G. Beauvais. 1999. Wyoming plant and animal species of special concern. Unpublished list of Wyoming Natural Diversity Database, Laramie.
- Fertig, W. and G. Jones. 1997. Plant species of special concern and plant associations of the Copper Mountain ecosystem, Fremont County, Wyoming. Report prepared for the BLM Wyoming State Office by the Wyoming Natural Diversity Database, Laramie, WY.
- Fertig, W., C. Refsdal, and J. Whipple. 1994. Wyoming Rare Plant Field Guide. Wyoming Rare Plant Technical Committee, Cheyenne, WY.
- Fertig, W. and L. Welp. 1998. Status report on Persistent-sepal yellowcress (*Rorippa calycina*) in Wyoming. Report prepared for the Bureau of Land Management Wyoming State Office by the Wyoming Natural Diversity Database, Laramie, WY.

- Great Plains Flora Association. 1977. Atlas of the Flora of the Great Plains. Iowa State University, Ames.
- Great Plains Flora Association. 1986. Flora of the Great Plains. Univ. Kansas Press, Lawrence.
- Greenlee, J. T. and R. M. Callaway. 1996. Abiotic stress and the relative importance of interference and facilitation in montane bunchgrass communities in western Montana. *Am. Nat.* 148:386-396.
- Heidel, B. L. 1994. Sensitive plant species survey – Garfield and McCone counties, Montana. Unpublished report to the Bureau of Land Management. Montana Natural Heritage Program, Helena.
- Heidel, B. L. 1999. Montana plant species of special concern. Unpublished list of Montana Natural Heritage Program, Helena.
- Heidel, B. L., S. V. Cooper and C. Jean. Plant species of special concern and plant associations of Sheridan County, Montana. Report to the U.S. Fish and Wildlife Service. Montana Natural Heritage Program, Helena.
- Heidel, B. L. and H. Marriott. 1996. Sensitive plant species survey in the Ashland District, Custer National Forest, Powder River and Rosebud counties. Unpublished report to the U.S. Forest Service. Montana Natural Heritage Program, Helena.
- Hitchcock, C. L. and A. Cronquist. 1961. Pt. 3. Saxifragaceae to Ericaceae. *In*: C.L. Hitchcock, A. Cronquist, M. Ownbey, and J.W. Thompson. Vascular Plants of the Pacific Northwest. University of Washington Press, Seattle.
- Hitchcock, C. L. and A. Cronquist. 1964. Pt. 2. Salicaceae to Saxifragaceae. *In*: C. L. Hitchcock, A. Cronquist, M. Ownbey, and J.W. Thompson. Vascular Plants of the Pacific Northwest. Univ. of Washington Publ. Biol. 17(2):1-597.
- Hitchcock, C. L., A. Cronquist, and M. Ownbey. 1969. Pt. 1. Vascular cryptogams, gymnosperms and monocotyledons. *In*: C.L. Hitchcock, A. Cronquist, M. Ownbey, and J.W. Thompson. Vascular Plants of the Pacific Northwest. Univ. of Washington Publ. Biol. 17(1):1-914.
- Hitchcock, C. L. and A. Cronquist. 1973. Flora of the Pacific Northwest. University of Washington Press, Seattle.
- Hudson, L. E. 1999. Climatic and hydrologic effects on the establishment of *Tamarix chinensis* in the cold desert of northern Wyoming (Bighorn Lake). Masters Thesis. University of Montana, Missoula.
- Isley, D. 1998. Native and Naturalized Leguminosae (Fabaceae) of the United States (exclusive of Alaska and Hawaii). Monte L. Bean Life Science Museum, Brigham Young Univ., Provo, UT.
- Knight, D. H., G. P. Jones, Y. Akashi, and R. W. Myers. 1987. Vegetation ecology in the Bighorn Canyon National Recreation Area, Wyoming and Montana. Report prepared for the US National Park Service and University of Wyoming-National Park Service Research Center.
- Lesica, P. 1995. Conservation status of *Lesquerella lesicii* in Montana. Unpublished report to the U.S. Forest Service and Bureau of Land Management. Montana Natural Heritage Program, Helena.
- Lesica, P. and P. L. Achuff. 1992. Distribution of vascular plant species of special concern and limited distribution in the Pryor Mountain desert, Carbon County, Montana. Unpublished report to the Bureau of Land Management. Montana Natural Heritage Program, Helena.
- Lesica, P., P. Husby and S. V. Cooper. 1998. New records for Montana. *Madrono* 45: 328-330.
- Lesica, P. and J. S. Shelly. 1991. Sensitive, Threatened and Endangered Vascular Plants of Montana. Montana Natural Heritage Program, Helena.
- Lichvar, Robert W. 1981. Field survey for *Rorippa calycina* (Engelm.) Rydb. Report prepared for the Bureau of Land Management by the Wyoming Natural Heritage Program, Cheyenne.
- Lichvar, R. W., E. I. Collins, and D. H. Knight. 1984. Checklist of vascular plants for the Bighorn Canyon National Recreation Area. Unpublished report for the Wyoming National Park Service Research Center and the Bighorn Canyon National Recreation Area.

- Lichvar, R. W., E. I. Collins, and D. H. Knight. 1985. Checklist of vascular plants for the Bighorn Canyon National Recreation Area, Wyoming and Montana. *Great Basin Naturalist* 45(4): 734-746.
- Marriott, H. and G. P. Jones. 1989. Special status plant surveys and plant community surveys in the Trapper Creek and Medicine Lodge Wilderness Study Areas and the Spanish Point Karst ACEC. Report prepared for the Worland District Office of the Bureau of Land Management by the Wyoming Natural Diversity Database, Laramie, WY.
- Marriott, H. and G. P. Jones. 1993. Special status plant surveys and plant community surveys in the Trapper Creek and Medicine Lodge Wilderness Study Areas and the Spanish Point Karst ACEC. Unpublished report prepared for the BLM Worland District by the Wyoming Natural Diversity Database, Laramie.
- Montana Natural Heritage Program. 1999. Montana Rare Plant Guide. Posted at: (<http://nris.state.mt.us/mtnhp/plants/>). Helena.
- Mulligan, G. A. and A. E. Porsild. 1966. *Rorippa calycina* in the Northwest Territories. *Canadian Journal of Botany* 44:1105-1106.
- Myers, R. W., D. H. Knight, G. P. Jones, and L. Frey. 1986. Vegetation map for the Bighorn Canyon National Recreation Area, Wyoming and Montana. Department of Botany, University of Wyoming, Laramie.
- Reveal, J. L. 1967. Notes on *Eriogonum* – III On the status of *Eriogonum pauciflorum* Pursh. *Great Basin Naturalist* 27:102-116.
- Reveal, J. L. 1969. A revision of the genus *Eriogonum* (Polygonaceae). Doctoral Dissertation, Brigham Young University, Provo, UT.
- Richards, P. W. 1955. Geology of the Bighorn Canyon – Hardin area, Wyoming and Montana. U.S. Geological Survey Bulletin 1026.
- Rollins, R. C. 1939. The cruciferous genus *Stanleya*. *Lloydia* 2:113-121.
- Rollins, R. C. 1993. The Cruciferae of Continental North America, Systematics of the Mustard Family from the Arctic to Panama. Stanford University Press, Stanford, CA.
- Rollins, R. C. 1995. Two *Lesquerellas* (Cruciferae) of south central and western Montana. *Novon* 5:71-75.
- Rydberg, P. A. 1917. Flora of the Rocky Mountains and Adjacent Plains, Colorado, Utah, Idaho, Saskatchewan, Alberta, and neighboring parts of Nebraska, South Dakota, North Dakota, and British Columbia. New York Botanical Garden, New York.
- Schassberger, L. A. and P. L. Achuff. 1991. Weeds and rare native plants in Montana. *Weed Symposium, Proc. Montana Acad. Sci.* 18-26.
- Sheley, R. L. and J. K. Petroff, eds. 1999. Biology and management of noxious rangeland weeds. Oregon State University Press, Corvallis.
- Soltis, D. E. 1991. A revision of *Sullivantia* (Saxifragaceae). *Brittonia* 43 (1) 27-53.
- Stokes, S. G. 1936. The genus *Eriogonum*. San Francisco: J.H. Neblett Pressroom, San Francisco, CA.
- Stuckey, R. L. 1972. Taxonomy and distribution of the genus *Rorippa* (Cruciferae) in North America. *Sida* 4:279-430.
- USDI Fish and Wildlife Service. 1993. National list of plant species that occur in wetlands. Region 9 – northwest (includes WA, OR, ID, w. MT, w. WY). Prepared by Resource Management Group, Inc. Grand Haven, MI.
- USDI Fish and Wildlife Service. 1994. National list of plant species that occur in wetlands. Regions 4, 5, and 8 – North Plains, Central Plains, and Intermountain. Prepared by Resource Management Group, Inc. Grand Haven, MI.
- USDI National Park Service. 1981. Final general management plan and environmental impact statement for Bighorn Canyon National Recreation Area, Montana - Wyoming. Denver, CO.

USDI National Park Service. 1988. Management Policies. "Endangered, threatened and rare species management", in: Chapter 4. Biological Resources. Washington, DC.

USDI National Park Service. 1998. Species in Parks: Flora and Fauna Databases. Posted at: (<http://ice.ucdavis.edu/nps/>)

Walter, H. 1973. Vegetation of the Earth. Springer-Verlag, New York.

Warnock, M. J. 1997. Ranunculaceae. *In*: Flora of North America, Vol. 3. Magnoliophyta. Oxford University Press, New York.

Welsh, S. 1998. Review of North American species of *Oxytropis* De Candolle (Leguminosae). Department of Botany and Range Science and Life Science Museum. Brigham Young University, Provo. Unpublished manuscript.

Williams, C. S. 1961. Distribution of vegetation in the Wind River Canyon, Wyoming. M.S. thesis, University of Wyoming, Laramie.

Williams, C. S. 1963. Ecology of bluebunch wheatgrass in northwestern Wyoming. PhD. Dissertation, University of Wyoming, Laramie.

Appendix A. Globally and state rare vascular plant species considered as inventory targets in Bighorn Canyon National Recreation Area

Scientific name	Common name	GRANK	MT-SRANK	WY-SRANK	Comments
GLOBALLY RARE					
<i>Erigeron allocotus</i>	Bighorn fleabane	G3	S3	S2S3	Previously collected in study area.
<i>Eriogonum brevicaulis</i> var. <i>canum</i>	Rabbit buckwheat	G3	S3	S2	Previously collected in study area.
<i>Lesquerella lesicii</i>	Lesica's bladderpod	G1	S1	Not in WY	Known from Pryor Mountains and study area.
<i>Penstemon caryi</i>	Cary's beardtongue	G3	S3	S2	Known from Pryor Mountains.
<i>Rorippa calycina</i>	Persistentsepal yellowcress	G3	S1	S2S3	Previously collected in study area.
<i>Shoshonea pulvinata</i>	Shoshonea	G2G3	S1	S2	Known from Pryor Mountains.
<i>Stanleya tomentosa</i> var. <i>tomentosa</i>	Hairy prince's-plume	G3T3	S3	S2	Previously collected in study area.
<i>Sullivantia hapemanii</i> var. <i>hapemanii</i>	Wyoming Sullivantia	G3T3	S1	S3	Previously collected in study area.

STATE RARE

<i>Agrimonia gryposepala</i>	Common agrimony	G5	SU	S1	Previously collected in study area. Added as watch.
<i>Arabis demissa</i> var. <i>languida</i>	Daggett rock cress	G4T4	S1	S2	Previously collected in study area and found in Pryors (Lesica et al. 1998). Added as species of concern.
<i>Aspidotis densa</i>	Pod-fern	G5	S3	S1	Collected during this study in MT; rare in WY.
<i>Aster glaucodes</i>	Gray aster	G4G5	S1	S3	Known from Pryor Mountains prior to this study.
<i>Astragalus aretioides</i>	Sweetwater milkvetch	G4	S2	S3	Previously collected in study area.
<i>Astragalus geyeri</i>	Geyer's milkvetch	G4T4	S2	S3	Known from Pryor Mountains prior to this study.
<i>Astragalus grayi</i>	Gray's milkvetch	G4?	S1	S3	Known from Pryor Mountains.
<i>Astragalus oreganus</i>	Wind River milkvetch	G4?	S1	S3	Known from Pryor Mountains prior to this study.
<i>Camissonia andina</i>	Obscure evening-primrose	G4	S1	S2	Known from Pryor Mountains.
<i>Camissonia parvula</i>	Small camissonia	G4	S1	S2S3	Known from Pryor Mountains.
<i>Carex gravida</i> var. <i>gravida</i>	Pregnant sedge	G5T?	S1		Collected during this study in MT.
<i>Carex parryana</i> var. <i>parryana</i>	Parry's sedge	G4T4	S3	S2	Collected during this study in MT; rare in WY.
<i>Cleome lutea</i>	Yellow bee plant	G5	S1	S3	Previously collected in study area.
<i>Coldenia nuttallii</i>	Tiquilia	G5	Not in MT	S2	Previously collected in WY segment of study area.

Appendix A. Globally and state rare vascular plant species considered as inventory targets in Bighorn Canyon National Recreation Area

Scientific name	Common name	GRANK	MT-SRANK	WY-SRANK	Comments
<i>Conioselinum scopulorum</i>	Hemlock parsley	G4	SRF	S2S3	Reported from Montana segment of study area and not otherwise known from the state; subsequently redetermined.
<i>Cryptantha flavoculata</i>	Pale yellow cryptantha	G5	S3	S4	Previously collected in study area; dropped from tracking as a species of concern in Montana.
<i>Cryptantha scoparia</i>	Miner's candle	G4	S1	S2	Known from Pryor Mountains.
<i>Delphinium geyeri</i>	Geyer's larkspur	G5	S1		Previously collected in study area.
<i>Eleocharis rostellata</i>	Beaked spikerush	G5	S2		Previously collected in Carbon Co.
<i>Epipactis gigantea</i>	Giant helleborine	G4	S2		Previously collected in Carbon Co.
<i>Eriogonum salsuginosum</i>	Smooth buckwheat	G4?	S1	S3	Known from Pryor Mountains prior to this study.
<i>Eriogonum mancum</i>	Mancos wild buckwheat	G4	S3	S1	Known from elsewhere in Bighorn Basin.
<i>Eupatorium maculatum</i> var. <i>bruneri</i>	Joe-pye weed	G5TU	S1	S2	Previously collected in study area.
<i>Grayia spinosa</i>	Spiny hopsage	G5	S2	S3S4S3	Previously collected in study area.
<i>Kochia americana</i>	Red sage	G5	S1	S3	Reported from study area; subsequently redetermined.
<i>Leptodactylon caespitosum</i>	Leptodactylon	G3G4	S1	S3	Previously collected in study area.
<i>Ligusticum porteri</i>	Porter's lovage	G4G5	SRF	S2S3	Reported from Montana segment of study area and not otherwise know from the state; subsequently redetermined.
<i>Malacothrix torreyi</i>	Desert dandelion	G4	S1	S2	Known from Pryor Mountains.
<i>Mentzelia pumila</i>	Dwarf mentzelia	G4	S2	S3	Previously collected in study area.
<i>Mentzelia montana</i>	White-bract stickleaf	G4	SH	S2	Previously collected in WY segment of study area; subsequently redetermined.
<i>Musineon vaginatum</i>	Sheathed musineon	G3G4	S3	S2	Previously collected in MT segment of study area; rare in WY.
<i>Nama densum</i>	Nama	G5	S1	S2	Previously collected in WY segment of study area; rare in MT.
<i>Oxytropis besseyi</i> var. <i>fallax</i>	Bessey's locoweed	G5T3	SU	S3	Recently collected in the study area from MT for the first time.

Appendix A. Globally and state rare vascular plant species considered as inventory targets in Bighorn Canyon National Recreation Area

Scientific name	Common name	GRANK	MT-SRANK	WY-SRANK	Comments
<i>Oxytropis besseyi</i> var. <i>ventosa</i>	Bessey's locoweed	G5T3	SU	S3	Previously known from MT. Collected during this study.
<i>Penstemon cleburnei</i>	Cleburn's beardtongue	G5T3?	Not in MT	S2S3	Not known from MT; known from nearby in WY.
<i>Penstemon humilis</i>	Low beardtongue	G5	Not in MT	S3S4	Not known from MT; known from nearby in WY.
<i>Penstemon laricifolius</i>	Larch-leaf beardtongue	G4	S3	S3S34	Previously collected in study area; dropped from tracking as a species of concern in Montana.
<i>Poa curta</i>	Short-leaved bluegrass	G4	S1	S1S2	Known from Pryor Mountains prior to this study.
<i>Potentilla plattensis</i>	Platte cinquefoil	G4	S1	S3	Known from Pryor Mountains prior to this study.
<i>Senecio eremophilus</i> var. <i>eremophilus</i>	Cut-leaved groundsel	G5T5	S1	S3	Previously collected in study area.
<i>Sphaeromeria capitata</i>	Rock-tansy	G3G4	S3	S3	Previously collected in study area; dropped from tracking as a species of concern in MT.
<i>Sphenopholis intermedia</i>	Slender wedgegrass	G5	SH	S2	Previously collected in study area.
<i>Stipa lettermanii</i>	Letterman's needlegrass	G5	S1	S3S4	Previously collected in study area.
<i>Suckeya suckleyana</i>	Poison suckleya	G5	SU	S2	Previously reported in WY segment of study area; rare in MT.
<i>Townsendia spathulata</i>	Sword Townsendia	G4	S3	S3	Previously collected in study area; dropped from tracking as a species of concern in MT.
<i>Triodanis leptocarpa</i>	Slim-pod Venus' looking-glass	G5?	S3	S1	Previously collected in MT segment of study area; rare in WY.

Appendix B. Draft Update to the Flora of Bighorn Canyon National Recreation Area

<i>Genus</i>	<i>Species</i>	<i>ssp. or variety</i>		<i>Family</i>	<i>Specimen</i>
<i>Abies</i>	<i>lasiocarpa</i>	var.	<i>lasiocarpa</i>	Pinaceae	BHC
<i>Abronia</i>	<i>fragrans</i>			Nyctaginaceae	BHC
<i>Abronia</i>	<i>micrantha</i>			Nyctaginaceae	BHC
<i>Acer</i>	<i>glabrum</i>	var.	<i>glabrum</i>	Aceraceae	BHC
<i>Acer</i>	<i>negundo</i>			Aceraceae	BHC
<i>Achillea</i>	<i>millefolium</i>			Asteraceae	BHC
<i>Achillea</i>	<i>millefolium</i>	var.	<i>lanulosa</i>	Asteraceae	BHC
<i>Actaea</i>	<i>rubra</i>			Ranunculaceae	BHC
<i>Aegilops</i>	<i>cylindrica</i>			Poaceae	BHC, MONTU 1849
<i>Agoseris</i>	<i>glauc</i>	var.	<i>laciniata</i>	Asteraceae	not collected/unknown
<i>Agoseris</i>	<i>glauc</i>	var.	<i>glauc</i>	Asteraceae	not collected/unknown
<i>Agoseris</i>	<i>glauc</i>	var.	<i>dasycephala</i>	Asteraceae	BHC
<i>Agrimonia</i>	<i>gryposepala</i>			Rosaceae	BHC
<i>Agrimonia</i>	<i>striata</i>			Rosaceae	RM, BHC 1924
<i>Agropyron</i>	<i>cristatum</i>			Poaceae	BHC
<i>Agropyron</i>	<i>elongatum</i>			Poaceae	Knight plot
<i>Agropyron</i>	<i>elongatum</i>			Poaceae	not collected/unknown
<i>Agropyron</i>	<i>repens</i>			Poaceae	Knight plot
<i>Agropyron</i>	<i>repens</i>			Poaceae	not collected/unknown
<i>Agropyron</i>	<i>riparium</i>			Poaceae	not collected/unknown
<i>Agropyron</i>	<i>riparium</i>			Poaceae	Knight plot
<i>Agropyron</i>	<i>scribneri</i>			Poaceae	MT-obs.
<i>Agropyron</i>	<i>smithii</i>			Poaceae	BHC
<i>Agropyron</i>	<i>spicatum</i>			Poaceae	BHC
<i>Agropyron</i>	<i>trachycaulum</i>			Poaceae	BHC
<i>Agrostis</i>	<i>alba</i>	var.	<i>palustris</i>	Poaceae	BHC
<i>Agrostis</i>	<i>exarata</i>			Poaceae	BHC
<i>Agrostis</i>	<i>scabra</i>			Poaceae	BHC
<i>Allium</i>	<i>brevistylum</i>			Liliaceae	BHC
<i>Allium</i>	<i>cernuum</i>			Liliaceae	BHC
<i>Allium</i>	<i>cernuum</i>			Liliaceae	BHC
<i>Allium</i>	<i>geyeri</i>	var.	<i>geyeri</i>	Liliaceae	BHC
<i>Allium</i>	<i>textile</i>			Liliaceae	BHC
<i>Alopecurus</i>	<i>pratensis</i>			Poaceae	MT-obs.
<i>Alyssum</i>	<i>alyssoides</i>			Brassicaceae	BHC
<i>Alyssum</i>	<i>desertorum</i>			Brassicaceae	misid?
<i>Amaranthus</i>	<i>alba</i>			Amaranthaceae	Knight plot
<i>Amaranthus</i>	<i>blitoides</i>			Amaranthaceae	BHC
<i>Ambrosia</i>	<i>artemisiifolia</i>	var.	<i>elatior</i>	Asteraceae	not collected/unknown
<i>Ambrosia</i>	<i>psilostachya</i>			Asteraceae	BHC
<i>Ambrosia</i>	<i>trifida</i>			Asteraceae	BHC
<i>Amelanchier</i>	<i>alnifolia</i>			Rosaceae	BHC
<i>Andropogon</i>	<i>gerardii</i>			Poaceae	BHC
<i>Andropogon</i>	<i>scoparius</i>			Poaceae	not collected/unknown
<i>Androsace</i>	<i>septentrionalis</i>			Primulaceae	not collected/unknown
<i>Anemone</i>	<i>cylindrica</i>			Ranunculaceae	misid?
<i>Anemone</i>	<i>multifida</i>			Ranunculaceae	BHC
<i>Anemone</i>	<i>patens</i>			Ranunculaceae	BHC
<i>Antennaria</i>	<i>corymbosa</i>			Asteraceae	Knight plot
<i>Antennaria</i>	<i>microphylla</i>			Asteraceae	BHC
<i>Antennaria</i>	<i>parvifolia</i>			Asteraceae	BHC

Appendix B. Draft Update to the Flora of Bighorn Canyon National Recreation Area

<i>Genus</i>	<i>Species</i>	<i>ssp. or variety</i>		<i>Family</i>	<i>Specimen</i>
<i>Antennaria</i>	<i>racemosa</i>			Asteraceae	not collected/unknown
<i>Apocynum</i>	<i>androsaemifolium</i>			Apocynaceae	BHC
<i>Apocynum</i>	<i>cannabinum</i>			Apocynaceae	BHC
<i>Arabis</i>	<i>demissa</i>	var.	<i>languida</i>	Brassicaceae	BHC
<i>Arabis</i>	<i>fendleri</i>			Brassicaceae	BHC
<i>Arabis</i>	<i>glabra</i>			Brassicaceae	BHC
<i>Arabis</i>	<i>hirsuta</i>			Brassicaceae	BHC
<i>Arabis</i>	<i>holboellii</i>	var.	<i>retrofracta</i>	Brassicaceae	BHC
<i>Arabis</i>	<i>holboellii</i>	var.	<i>pendulocarpa</i>	Brassicaceae	BHC
<i>Arabis</i>	<i>lignifera</i>			Brassicaceae	BHC
<i>Arabis</i>	<i>microphylla</i>	var.	<i>saximontana</i>	Brassicaceae	BHC
<i>Arabis</i>	<i>nuttallii</i>			Brassicaceae	BHC
<i>Arabis</i>	<i>sparsiflora</i>			Brassicaceae	not collected/unknown
<i>Arctium</i>	<i>minus</i>			Asteraceae	BHC
<i>Arenaria</i>	<i>congesta</i>			Caryophyllaceae	BHC
<i>Arenaria</i>	<i>hookeri</i>	ssp.	<i>hookeri</i>	Caryophyllaceae	BHC
<i>Arenaria</i>	<i>hookeri</i>			Caryophyllaceae	BHC
<i>Arenaria</i>	<i>nuttallii</i>			Caryophyllaceae	BHC
<i>Arenaria</i>	<i>obtusiloba</i>			Caryophyllaceae	BHC
<i>Arenaria</i>	<i>serpyllifolia</i>			Caryophyllaceae	MONTU 1861
<i>Aristida</i>	<i>fendleriana</i>			Poaceae	BHC
<i>Aristida</i>	<i>longiseta</i>			Poaceae	BHC
<i>Arnica</i>	<i>cordifolia</i>			Asteraceae	BHC
<i>Arnica</i>	<i>fulgens</i>			Asteraceae	BHC
<i>Arnica</i>	<i>latifolia</i>			Asteraceae	BHC
<i>Arnica</i>	<i>rydbergii</i>			Asteraceae	misid?
<i>Arnica</i>	<i>sororia</i>			Asteraceae	BHC
<i>Artemisia</i>	<i>annua</i>			Asteraceae	BHC 1814
<i>Artemisia</i>	<i>campestris</i>			Asteraceae	BHC
<i>Artemisia</i>	<i>campestris</i>	ssp.	<i>borealis</i>	Asteraceae	BHC
<i>Artemisia</i>	<i>cana</i>	ssp.	<i>cana</i>	Asteraceae	BHC
<i>Artemisia</i>	<i>dracunculus</i>			Asteraceae	BHC
<i>Artemisia</i>	<i>frigida</i>			Asteraceae	BHC
<i>Artemisia</i>	<i>longifolia</i>			Asteraceae	Knight plot
<i>Artemisia</i>	<i>longifolia</i>			Asteraceae	BHC
<i>Artemisia</i>	<i>ludoviciana</i>	ssp.	<i>ludoviciana</i>	Asteraceae	BHC
<i>Artemisia</i>	<i>ludoviciana</i>			Asteraceae	BHC
<i>Artemisia</i>	<i>nova</i>			Asteraceae	BHC
<i>Artemisia</i>	<i>spinescens</i>			Asteraceae	BHC
<i>Artemisia</i>	<i>tridentata</i>	ssp.	<i>tridentata</i>	Asteraceae	BHC
<i>Artemisia</i>	<i>tridentata</i>	ssp.	<i>vaseyana</i>	Asteraceae	BHC
<i>Artemisia</i>	<i>biennis</i>			Asteraceae	misid?
<i>Asclepias</i>	<i>speciosa</i>			Asclepiadaceae	BHC
<i>Asparagus</i>	<i>officinalis</i>			Liliaceae	BHC
<i>Asperugo</i>	<i>procumbens</i>			Boraginaceae	BHC
<i>Aspidotis</i>	<i>densa</i>			Polypodiaceae	MONTU 1714
<i>Aster</i>	<i>alpigenus</i>			Asteraceae	MT-obs.
<i>Aster</i>	<i>chilensis</i>	ssp.	<i>adscendens</i>	Asteraceae	not collected/unknown
<i>Aster</i>	<i>ciliolatus</i>			Asteraceae	BHC
<i>Aster</i>	<i>eatonii</i>			Asteraceae	BHC
<i>Aster</i>	<i>falcatus</i>			Asteraceae	not collected/unknown

Appendix B. Draft Update to the Flora of Bighorn Canyon National Recreation Area

<i>Genus</i>	<i>Species</i>	<i>ssp. or variety</i>		<i>Family</i>	<i>Specimen</i>
<i>Aster</i>	<i>foliaceus</i>			Asteraceae	not collected/unknown
<i>Aster</i>	<i>glaucodes</i>			Asteraceae	BHC, MONTU 1927
<i>Aster</i>	<i>hesperius</i>			Asteraceae	not collected/unknown
<i>Astragalus</i>	<i>adsurgens</i>			Fabaceae	BHC
<i>Astragalus</i>	<i>agrestis</i>			Fabaceae	misid?
<i>Astragalus</i>	<i>bisulcatus</i>			Fabaceae	not collected/unknown
<i>Astragalus</i>	<i>bourgovii</i>			Fabaceae	MT-obs.
<i>Astragalus</i>	<i>canadensis</i>	var.	<i>canadensis</i>	Fabaceae	not collected/unknown
<i>Astragalus</i>	<i>ceramicus</i>	var.	<i>cermicus</i>	Fabaceae	BHC
<i>Astragalus</i>	<i>chamaeleuce</i>			Fabaceae	BHC
<i>Astragalus</i>	<i>crassicaupus</i>			Fabaceae	BHC
<i>Astragalus</i>	<i>crassicaupus</i>	var.	<i>paysonii</i>	Fabaceae	BHC
<i>Astragalus</i>	<i>drummondii</i>			Fabaceae	BHC
<i>Astragalus</i>	<i>geyeri</i>	var.	<i>geyeri</i>	Fabaceae	BHC
<i>Astragalus</i>	<i>gilviflorus</i>			Fabaceae	BHC
<i>Astragalus</i>	<i>gracilis</i>			Fabaceae	BHC
<i>Astragalus</i>	<i>hyalinus</i>			Fabaceae	BHC
<i>Astragalus</i>	<i>kentrophyta</i>			Fabaceae	not collected/unknown
<i>Astragalus</i>	<i>lagopus</i>			Fabaceae	Knight plot
<i>Astragalus</i>	<i>lotiflorus</i>			Fabaceae	BHC
<i>Astragalus</i>	<i>miser</i>	var.	<i>praeteritus</i>	Fabaceae	MONTU 1719
<i>Astragalus</i>	<i>miser</i>	var.	<i>decumbens</i>	Fabaceae	BHC
<i>Astragalus</i>	<i>missouriensis</i>			Fabaceae	BHC
<i>Astragalus</i>	<i>oreganus</i>			Fabaceae	BHC
<i>Astragalus</i>	<i>purshii</i>	var.	<i>purshii</i>	Fabaceae	BHC
<i>Astragalus</i>	<i>shortianus</i>			Fabaceae	BHC
<i>Astragalus</i>	<i>spatulatus</i>			Fabaceae	BHC
<i>Atriplex</i>	<i>argentea</i>			Chenopodiaceae	BHC
<i>Atriplex</i>	<i>canescens</i>			Chenopodiaceae	BHC
<i>Atriplex</i>	<i>confertifolia</i>			Chenopodiaceae	BHC
<i>Atriplex</i>	<i>gardneri</i>			Chenopodiaceae	BHC
<i>Atriplex</i>	<i>heterosperma</i>			Chenopodiaceae	BHC
<i>Balsamorhiza</i>	<i>incana</i>			Asteraceae	BHC
<i>Balsamorhiza</i>	<i>sagittata</i>			Asteraceae	BHC
<i>Barbarea</i>	<i>orthoceras</i>			Brassicaceae	BHC
<i>Berula</i>	<i>erecta</i>	var.	<i>incisa</i>	Apiaceae	BHC
<i>Besseyia</i>	<i>wyomingensis</i>			Scrophulariaceae	BHC
<i>Betula</i>	<i>occidentalis</i>			Betulaceae	BHC
<i>Bidens</i>	<i>cernua</i>			Asteraceae	not collected/unknown
<i>Bouteloua</i>	<i>curtipendula</i>			Poaceae	BHC
<i>Bouteloua</i>	<i>gracilis</i>			Poaceae	BHC
<i>Boykinia</i>	<i>heucheriformis</i>			Saxifragaceae	MONTU
<i>Brachyactis</i>	<i>ciliata</i>	ssp.	<i>angusta</i>	Asteraceae	MONTU 1734
<i>Brickellia</i>	<i>eupatorioides</i>			Asteraceae	MT-obs.
<i>Brickellia</i>	<i>grandiflora</i>			Asteraceae	BHC
<i>Bromus</i>	<i>carinatus</i>			Poaceae	BHC
<i>Bromus</i>	<i>ciliatus</i>			Poaceae	BHC
<i>Bromus</i>	<i>commutatus</i>			Poaceae	BHC
<i>Bromus</i>	<i>inermis</i>			Poaceae	BHC
<i>Bromus</i>	<i>japonicus</i>			Poaceae	not collected/unknown
<i>Bromus</i>	<i>tectorum</i>			Poaceae	BHC

Appendix B. Draft Update to the Flora of Bighorn Canyon National Recreation Area

<i>Genus</i>	<i>Species</i>	<i>ssp. or variety</i>		<i>Family</i>	<i>Specimen</i>
<i>Bupleurum</i>	<i>americanum</i>			Apiaceae	BHC
<i>Calamagrostis</i>	<i>purpurascens</i>			Poaceae	BHC
<i>Calamovilfa</i>	<i>longifolia</i>			Poaceae	BHC
<i>Calochortus</i>	<i>gunnisonii</i>			Liliaceae	BHC
<i>Calochortus</i>	<i>nutallii</i>			Liliaceae	BHC
<i>Calylophus</i>	<i>serrulatus</i>			Onagraceae	BHC
<i>Camelina</i>	<i>microcarpa</i>			Brassicaceae	BHC
<i>Camissonia</i>	<i>andina</i>			Onagraceae	not collected/unknown
<i>Camissonia</i>	<i>minor</i>			Onagraceae	BHC
<i>Camissonia</i>	<i>scapoidea</i>			Onagraceae	BHC
<i>Campanula</i>	<i>rotundifolia</i>			Campanulaceae	BHC
<i>Capsella</i>	<i>bursa-pastoris</i>			Brassicaceae	BHC
<i>Cardaria</i>	<i>chalepensis</i>			Brassicaceae	BHC
<i>Cardaria</i>	<i>pubescens</i>			Brassicaceae	BHC
<i>Carex</i>	<i>aquatilis</i>			Cyperaceae	BHC
<i>Carex</i>	<i>aurea</i>			Cyperaceae	BHC, MONTU 1708
<i>Carex</i>	<i>brevior</i>			Cyperaceae	MT-obs.
<i>Carex</i>	<i>canescens</i>			Cyperaceae	MT-obs.
<i>Carex</i>	<i>elynoides</i>			Cyperaceae	not collected/unknown
<i>Carex</i>	<i>filifolia</i>			Cyperaceae	BHC
<i>Carex</i>	<i>foenea</i>			Cyperaceae	BHC
<i>Carex</i>	<i>gravida</i>	var.	<i>gravida</i>	Cyperaceae	BHC, MICH 1923
<i>Carex</i>	<i>heliophila</i>			Cyperaceae	BHC
<i>Carex</i>	<i>hoodii</i>			Cyperaceae	BHC
<i>Carex</i>	<i>hystericina</i>			Cyperaceae	MONTU 1716
<i>Carex</i>	<i>interior</i>			Cyperaceae	BHC
<i>Carex</i>	<i>lanuginosa</i>			Cyperaceae	BHC
<i>Carex</i>	<i>microptera</i>			Cyperaceae	BHC
<i>Carex</i>	<i>nebrascensis</i>			Cyperaceae	not collected/unknown
<i>Carex</i>	<i>parryana</i>			Cyperaceae	BHC
<i>Carex</i>	<i>raynoldsii</i>			Cyperaceae	BHC
<i>Carex</i>	<i>rossii</i>			Cyperaceae	MT-obs.
<i>Carex</i>	<i>rostrata</i>			Cyperaceae	not collected/unknown
<i>Carex</i>	<i>scopulorum</i>			Cyperaceae	MT-obs.
<i>Carex</i>	<i>sprengelii</i>			Cyperaceae	BHC
<i>Carex</i>	<i>stipata</i>			Cyperaceae	BHC, MONTU 1858
<i>Carex</i>	<i>vallicola</i>			Cyperaceae	BHC
<i>Carex</i>	<i>viridula</i>			Cyperaceae	not collected/unknown
<i>Carex</i>	<i>viridula</i>			Cyperaceae	BHC
<i>Castilleja</i>	<i>angustifolia</i>			Scrophulariaceae	BHC
<i>Castilleja</i>	<i>chromosa</i>			Scrophulariaceae	BHC
<i>Castilleja</i>	<i>miniata</i>			Scrophulariaceae	BHC
<i>Castilleja</i>	<i>pulchella</i>			Scrophulariaceae	BHC
<i>Castilleja</i>	<i>sessiliflora</i>			Scrophulariaceae	BHC
<i>Catabrosa</i>	<i>aquatica</i>			Poaceae	MONTU 1858
<i>Celtis</i>	<i>occidentalis</i>			Ulmaceae	BHC
<i>Centaurea</i>	<i>diffusa</i>			Asteraceae	not collected/unknown
<i>Centaurea</i>	<i>maculosa</i>			Asteraceae	BHC
<i>Centaurea</i>	<i>repens</i>			Asteraceae	BHC
<i>Cerastium</i>	<i>arvense</i>			Caryophyllaceae	BHC
<i>Cerastium</i>	<i>nutans</i>	var.	<i>nutans</i>	Caryophyllaceae	BHC

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<i>Genus</i>	<i>Species</i>	<i>ssp. or variety</i>		<i>Family</i>	<i>Specimen</i>
<i>Ceratoides</i>	<i>lanata</i>			Chenopodiaceae	BHC
<i>Cercocarpus</i>	<i>ledifolius</i>			Rosaceae	BHC
<i>Chaenactis</i>	<i>douglasii</i>	var.	<i>montana</i>	Asteraceae	BHC
<i>Cheilanthes</i>	<i>feeii</i>			Adiantaceae	BHC
<i>Chenopodium</i>	<i>album</i>			Chenopodiaceae	BHC
<i>Chenopodium</i>	<i>atrovirens</i>			Chenopodiaceae	BHC
<i>Chenopodium</i>	<i>berlandieri</i>			Chenopodiaceae	BHC
<i>Chenopodium</i>	<i>fremontii</i>			Chenopodiaceae	BHC
<i>Chenopodium</i>	<i>glaucum</i>			Chenopodiaceae	Knight plot
<i>Chenopodium</i>	<i>leptophyllum</i>			Chenopodiaceae	BHC
<i>Chenopodium</i>	<i>pratericola</i>			Chenopodiaceae	BHC
<i>Chenopodium</i>	<i>rubrum</i>			Chenopodiaceae	Knight plot
<i>Chorispora</i>	<i>tenella</i>			Brassicaceae	BHC
<i>Chrysanthemum</i>	<i>leucanthemum</i>			Asteraceae	not collected/unknown
<i>Chrysothamnus</i>	<i>linifolius</i>			Asteraceae	RM 18404
<i>Chrysothamnus</i>	<i>nauseosus</i>	var.	<i>nauseosus</i>	Asteraceae	RM 18381
<i>Chrysothamnus</i>	<i>nauseosus</i>	var.	<i>graveolens</i>	Asteraceae	RM 18397
<i>Chrysothamnus</i>	<i>nauseosus</i>			Asteraceae	BHC
<i>Chrysothamnus</i>	<i>viscidiflorus</i>	ssp.	<i>viscidiflorus</i>	Asteraceae	BHC
<i>Chrysothamnus</i>	<i>viscidiflorus</i>	var.	<i>latifolius</i>	Asteraceae	not collected/unknown
<i>Cichorium</i>	<i>intybus</i>			Asteraceae	BHC
<i>Cicuta</i>	<i>douglasii</i>			Apiaceae	MONTU
<i>Cinna</i>	<i>latifolia</i>			Poaceae	MT-obs.
<i>Circaea</i>	<i>alpina</i>	ssp.	<i>alpina</i>	Onagraceae	BHC
<i>Cirsium</i>	<i>arvense</i>			Asteraceae	BHC
<i>Cirsium</i>	<i>flodmanii</i>			Asteraceae	not collected/unknown
<i>Cirsium</i>	<i>tweedyi</i>			Asteraceae	BHC
<i>Cirsium</i>	<i>undulatum</i>			Asteraceae	BHC
<i>Cirsium</i>	<i>vulgare</i>			Asteraceae	BHC
<i>Claytonia</i>	<i>lanceolata</i>	var.	<i>lanceolata</i>	Portulacaceae	BHC
<i>Claytonia</i>	<i>perfoliata</i>			Portulacaceae	BHC
<i>Clematis</i>	<i>columbiana</i>	var.	<i>tenuiloba</i>	Ranunculaceae	BHC
<i>Clematis</i>	<i>ligusticifolia</i>			Ranunculaceae	BHC
<i>Cleome</i>	<i>lutea</i>			Capparaceae	BHC
<i>Cleome</i>	<i>serrulata</i>			Capparaceae	misid?
<i>Coldenia</i>	<i>nuttallii</i>			Boraginaceae	not collected/unknown
<i>Collinsia</i>	<i>parviflora</i>			Scrophulariaceae	BHC
<i>Comandra</i>	<i>umbellata</i>	var.	<i>pallida</i>	Santalaceae	BHC
<i>Conimitella</i>	<i>williamsii</i>			Saxifragaceae	BHC
<i>Conioselinum</i>	<i>scopulorum</i>			Apiaceae	false report
<i>Conium</i>	<i>maculatum</i>			Apiaceae	BHC
<i>Convolvulus</i>	<i>arvensis</i>			Convolvulaceae	BHC
<i>Conyza</i>	<i>canadensis</i>			Asteraceae	BHC
<i>Corallorrhiza</i>	<i>maculata</i>			Orchidaceae	BHC
<i>Corallorrhiza</i>	<i>striata</i>			Orchidaceae	BHC
<i>Corispermum</i>	<i>hyssopifolium</i>			Chenopodiaceae	BHC
<i>Cornus</i>	<i>stolonifera</i>			Cornaceae	BHC
<i>Corydalis</i>	<i>aurea</i>			Fumariaceae	BHC
<i>Coryphantha</i>	<i>vivipara</i>			Cactaceae	MT-obs.; possibly Pediocactus
<i>Crataegus</i>	<i>douglasii</i>			Rosaceae	not collected/unknown
<i>Crepis</i>	<i>acuminata</i>			Asteraceae	BHC

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<i>Genus</i>	<i>Species</i>	<i>ssp. or variety</i>		<i>Family</i>	<i>Specimen</i>
<i>Crepis</i>	<i>atribarba</i>			Asteraceae	BHC
<i>Crepis</i>	<i>intermedia</i>			Asteraceae	BHC
<i>Crepis</i>	<i>modocensis</i>			Asteraceae	BHC
<i>Crepis</i>	<i>runcinata</i>	ssp.	<i>glauc</i>	Asteraceae	MONTU, BHC1725
<i>Cryptantha</i>	<i>caespitosa</i>			Boraginaceae	BHC
<i>Cryptantha</i>	<i>cana</i>			Boraginaceae	BHC
<i>Cryptantha</i>	<i>celosioides</i>			Boraginaceae	BHC
<i>Cryptantha</i>	<i>flavoculata</i>			Boraginaceae	BHC
<i>Cryptantha</i>	<i>kelseyana</i>			Boraginaceae	BHC
<i>Cymopterus</i>	<i>acaulis</i>			Apiaceae	BHC
<i>Cymopterus</i>	<i>terebinthinus</i>			Apiaceae	BHC, MONTU 1812
<i>Cynoglossum</i>	<i>officinale</i>			Boraginaceae	BHC
<i>Cystopteris</i>	<i>fragilis</i>			Dryopteridaceae	BHC
<i>Cytisus</i>	<i>scoparius</i>			Fabaceae	BHC
<i>Dactylis</i>	<i>glomerata</i>			Poaceae	BHC
<i>Danthonia</i>	<i>californica</i>			Poaceae	BHC, MONTU 1860
<i>Danthonia</i>	<i>intermedia</i>			Poaceae	MT-obs.
<i>Delphinium</i>	<i>bicolor</i>			Poaceae	BHC
<i>Delphinium</i>	<i>geyeri</i>			Poaceae	MONT
<i>Deschampsia</i>	<i>cespitosa</i>			Poaceae	BHC
<i>Descurainia</i>	<i>pinnata</i>	var.	<i>halictorum</i>	Brassicaceae	BHC
<i>Descurainia</i>	<i>pinnata</i>			Brassicaceae	BHC
<i>Descurainia</i>	<i>richardsonii</i>			Brassicaceae	BHC
<i>Descurainia</i>	<i>sophia</i>			Brassicaceae	BHC
<i>Dichanthelium</i>	<i>acuminatum</i>	var.	<i>lanuginosum</i>	Poaceae	MONTU, BHC, MRC 1720
<i>Disporum</i>	<i>trachycarpum</i>			Liliaceae	BHC
<i>Distichlis</i>	<i>spicata</i>			Poaceae	BHC
<i>Dodecatheon</i>	<i>conjugens</i>			Primulaceae	MT-obs.
<i>Dodecatheon</i>	<i>pulchellum</i>			Primulaceae	BHC
<i>Draba</i>	<i>crassifolia</i>			Brassicaceae	BHC
<i>Draba</i>	<i>nemorosa</i>			Brassicaceae	BHC
<i>Draba</i>	<i>oligosperma</i>			Brassicaceae	BHC
<i>Draba</i>	<i>praealta</i>			Brassicaceae	misid?
<i>Draba</i>	<i>reptans</i>			Brassicaceae	BHC
<i>Draba</i>	<i>stenoloba</i>			Brassicaceae	not collected/unknown
<i>Dyssodia</i>	<i>papposa</i>			Asteraceae	BHC
<i>Echinacea</i>	<i>pallida</i>	var.	<i>angustifolia</i>	Asteraceae	not collected/unknown
<i>Echinochloa</i>	<i>crusgalli</i>			Poaceae	not collected/unknown
<i>Elaeagnus</i>	<i>angustifolia</i>			Elaeagnaceae	BHC
<i>Eleocharis</i>	<i>palustris</i>			Cyperaceae	BHC
<i>Eleocharis</i>	<i>pauciflora</i>			Cyperaceae	BHC, MONTU 1717
<i>Elymus</i>	<i>canadensis</i>			Poaceae	BHC
<i>Elymus</i>	<i>cinereus</i>			Poaceae	BHC
<i>Elymus</i>	<i>glaucus</i>			Poaceae	BHC
<i>Elymus</i>	<i>virginicus</i>			Poaceae	BHC
<i>Epilobium</i>	<i>angustifolium</i>			Onagraceae	BHC
<i>Epilobium</i>	<i>ciliatum</i>	ssp.	<i>glandulosum</i>	Onagraceae	BHC
<i>Epilobium</i>	<i>ciliatum</i>	ssp.	<i>ciliatum</i>	Onagraceae	BHC
<i>Epilobium</i>	<i>paniculatum</i>			Onagraceae	not collected/unknown
<i>Equisetum</i>	<i>arvense</i>			Equisetaceae	BHC
<i>Equisetum</i>	<i>hyemale</i>			Equisetaceae	BHC

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<i>Genus</i>	<i>Species</i>	<i>ssp. or variety</i>		<i>Family</i>	<i>Specimen</i>
<i>Equisetum</i>	<i>laevigatum</i>			Equisetaceae	BHC
<i>Erigeron</i>	<i>allocotus</i>			Asteraceae	BHC
<i>Erigeron</i>	<i>caespitosus</i>			Asteraceae	BHC
<i>Erigeron</i>	<i>compositus</i>			Asteraceae	misid?
<i>Erigeron</i>	<i>corymbosus</i>			Asteraceae	BHC
<i>Erigeron</i>	<i>glabellus</i>			Asteraceae	BHC
<i>Erigeron</i>	<i>linearis</i>			Asteraceae	Knight plot
<i>Erigeron</i>	<i>ochroleucus</i>	var.	<i>scribneri</i>	Asteraceae	BHC
<i>Erigeron</i>	<i>pumilus</i>	ssp.	<i>pumilus</i>	Asteraceae	BHC
<i>Erigeron</i>	<i>speciosus</i>			Asteraceae	BHC
<i>Erigeron</i>	<i>strigosus</i>			Asteraceae	BUC
<i>Eriogonum</i>	<i>annuum</i>			Polygonaceae	BHC
<i>Eriogonum</i>	<i>brevicaule</i>	var.	<i>canum</i>	Polygonaceae	BHC
<i>Eriogonum</i>	<i>caespitosum</i>			Polygonaceae	Knight plot
<i>Eriogonum</i>	<i>cernuum</i>			Polygonaceae	BHC
<i>Eriogonum</i>	<i>cernuum</i>			Polygonaceae	BHC
<i>Eriogonum</i>	<i>flavum</i>			Polygonaceae	BHC
<i>Eriogonum</i>	<i>flavum</i>	var.	<i>flavum</i>	Polygonaceae	BHC
<i>Eriogonum</i>	<i>mancum</i>			Polygonaceae	BHC
<i>Eriogonum</i>	<i>ovalifolia</i>	var.	<i>purpureum</i>	Polygonaceae	MONTU 1851
<i>Eriogonum</i>	<i>ovalifolium</i>	var.	<i>ovalifolium</i>	Polygonaceae	BHC
<i>Eriogonum</i>	<i>ovalifolium</i>			Polygonaceae	BHC
<i>Eriogonum</i>	<i>pauciflorum</i>			Polygonaceae	BHC
<i>Eriogonum</i>	<i>pauciflorum</i>			Polygonaceae	BHC
<i>Eriogonum</i>	<i>umbellatum</i>			Polygonaceae	BHC
<i>Eritrichium</i>	<i>howardii</i>			Boraginaceae	not collected/unknown
<i>Erodium</i>	<i>cicutarium</i>			Geraniaceae	BHC
<i>Erysimum</i>	<i>asperum</i>			Brassicaceae	BHC
<i>Erysimum</i>	<i>cheiranthoides</i>			Brassicaceae	BHC
<i>Erysimum</i>	<i>inconspicuum</i>			Brassicaceae	BHC
<i>Eupatorium</i>	<i>maculatum</i>	var.	<i>bruneri</i>	Asteraceae	BHC
<i>Euphorbia</i>	<i>cyparissias</i>			Euphorbiaceae	not collected/unknown
<i>Euphorbia</i>	<i>esula</i>			Euphorbiaceae	not collected/unknown
<i>Euphorbia</i>	<i>glyptosperma</i>			Euphorbiaceae	BHC
<i>Euphorbia</i>	<i>missurica</i>			Euphorbiaceae	BHC
<i>Euphorbia</i>	<i>robusta</i>			Euphorbiaceae	BHC
<i>Evolvulus</i>	<i>nuttallianus</i>			Convolvulaceae	MT-obs.
<i>Festuca</i>	<i>idahoensis</i>			Poaceae	BHC
<i>Festuca</i>	<i>octoflora</i>			Poaceae	BHC
<i>Festuca</i>	<i>rubra</i>			Poaceae	MONT 1920
<i>Fragaria</i>	<i>vesca</i>			Rosaceae	BHC
<i>Fragaria</i>	<i>virginiana</i>			Rosaceae	BHC
<i>Frasera</i>	<i>speciosa</i>			Gentianaceae	not collected/unknown
<i>Fritillaria</i>	<i>pudica</i>			Liliaceae	not collected/unknown
<i>Gaillardia</i>	<i>aristata</i>			Asteraceae	Knight plot, MT obs.
<i>Galium</i>	<i>boreale</i>			Rubiaceae	BHC
<i>Galium</i>	<i>trifidum</i>			Rubiaceae	not collected/unknown
<i>Galium</i>	<i>triflorum</i>			Rubiaceae	BHC
<i>Gaura</i>	<i>coccinea</i>			Onagraceae	BHC
<i>Gaura</i>	<i>parviflora</i>			Onagraceae	BHC
<i>Gayophytum</i>	<i>ramosissimum</i>			Onagraceae	misid?

Appendix B. Draft Update to the Flora of Bighorn Canyon National Recreation Area

<i>Genus</i>	<i>Species</i>	<i>ssp. or variety</i>		<i>Family</i>	<i>Specimen</i>
<i>Gentiana</i>	<i>affinis</i>			Gentianaceae	BHC
<i>Geranium</i>	<i>bicknellii</i>			Geraniaceae	MT-obs.
<i>Geranium</i>	<i>viscosissimum</i>	var.	<i>viscosissimum</i>	Geraniaceae	BHC
<i>Geum</i>	<i>aleppicum</i>			Rosaceae	BHC
<i>Geum</i>	<i>macrophyllum</i>			Rosaceae	BHC
<i>Geum</i>	<i>triflorum</i>			Rosaceae	BHC
<i>Geum</i>	<i>triflorum</i>	var.	<i>triflorum</i>	Rosaceae	BHC
<i>Gilia</i>	<i>leptomeria</i>			Polemoniaceae	BHC
<i>Gilia</i>	<i>pinnatifida</i>			Polemoniaceae	not collected/unknown
<i>Gilia</i>	<i>tweedyi</i>			Polemoniaceae	not collected/unknown
<i>Glyceria</i>	<i>striata</i>			Poaceae	BHC
<i>Glycyrrhiza</i>	<i>lepidota</i>			Fabaceae	BHC
<i>Gnaphalium</i>	<i>palustre</i>			Asteraceae	Knight plot
<i>Goodyera</i>	<i>oblongifolia</i>			Orchidaceae	BHC
<i>Grayia</i>	<i>spinosa</i>			Chenopodiaceae	BHC
<i>Grindelia</i>	<i>squarrosa</i>			Asteraceae	BHC
<i>Gutierrezia</i>	<i>sarothrae</i>			Asteraceae	BHC
<i>Hackelia</i>	<i>deflexa</i>			Boraginaceae	BHC
<i>Hackelia</i>	<i>floribunda</i>			Boraginaceae	BHC
<i>Halogeton</i>	<i>glomeratus</i>			Chenopodiaceae	BHC
<i>Haplopappus</i>	<i>armerioides</i>			Asteraceae	BHC
<i>Hedeoma</i>	<i>drummondii</i>			Lamiaceae	BHC
<i>Hedysarum</i>	<i>boreale</i>			Fabaceae	BHC
<i>Hedysarum</i>	<i>sulphurescens</i>			Fabaceae	BHC
<i>Helianthella</i>	<i>quinquenervis</i>			Asteraceae	misid?
<i>Helianthus</i>	<i>annuus</i>			Asteraceae	not collected/unknown
<i>Helianthus</i>	<i>nuttallii</i>			Asteraceae	BHC
<i>Helianthus</i>	<i>petiolaris</i>			Asteraceae	BHC
<i>Helianthus</i>	<i>rigidus</i>			Asteraceae	BHC
<i>Heracleum</i>	<i>sphondylium</i>			Apiaceae	BHC
<i>Hesperis</i>	<i>matronalis</i>			Brassicaceae	BHC
<i>Heterotheca</i>	<i>villosa</i>			Asteraceae	BHC
<i>Heuchera</i>	<i>parvifolia</i>			Saxifragaceae	BHC
<i>Hieracium</i>	<i>albiflorus</i>			Asteraceae	BHC
<i>Hieracium</i>	<i>cynoglossoides</i>			Asteraceae	not collected/unknown
<i>Hippuris</i>	<i>vulgaris</i>			Hippuridaceae	BHC 1937
<i>Hordeum</i>	<i>jubatum</i>			Poaceae	BHC
<i>Hordeum</i>	<i>pusillum</i>			Poaceae	MT-obs.
<i>Humulus</i>	<i>lupulus</i>	var.	<i>neomexicanus</i>	Cannabaceae	not collected/unknown
<i>Hymenopappus</i>	<i>filifolius</i>	var.	<i>filifolius</i>	Asteraceae	BHC
<i>Hymenoxys</i>	<i>acaulis</i>			Asteraceae	BHC
<i>Hymenoxys</i>	<i>torreyana</i>			Asteraceae	not collected/unknown
<i>Ipomoea</i>	<i>leptophylla</i>			Convolvulaceae	not collected/unknown
<i>Ipomopsis</i>	<i>pumila</i>			Polemoniaceae	BHC
<i>Ipomopsis</i>	<i>spicata</i>			Polemoniaceae	BHC
<i>Iris</i>	<i>missouriensis</i>			Iridaceae	BHC
<i>Iva</i>	<i>axillaris</i>			Asteraceae	BHC
<i>Iva</i>	<i>xanthifolia</i>			Asteraceae	BHC
<i>Juglans</i>	<i>cinerea</i>			Juglandaceae	BHC
<i>Juncus</i>	<i>balticus</i>			Juncaceae	BHC
<i>Juncus</i>	<i>compressus</i>			Juncaceae	Knight plot

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<i>Genus</i>	<i>Species</i>	<i>ssp. or variety</i>		<i>Family</i>	<i>Specimen</i>
<i>Juncus</i>	<i>ensifolius</i>			Juncaceae	BHC
<i>Juncus</i>	<i>longistylis</i>			Juncaceae	BHC
<i>Juncus</i>	<i>parryi</i>			Juncaceae	BHC
<i>Juncus</i>	<i>regelii</i>			Juncaceae	not collected/unknown
<i>Juncus</i>	<i>tenuis</i>	var.	<i>tenuis</i>	Juncaceae	BHC
<i>Juncus</i>	<i>tenuis</i>	var.	<i>dudleyi</i>	Juncaceae	not collected/unknown
<i>Juncus</i>	<i>torreyi</i>			Juncaceae	BHC
<i>Juniperus</i>	<i>communis</i>			Cupressaceae	BHC
<i>Juniperus</i>	<i>horizontalis</i>			Cupressaceae	BHC
<i>Juniperus</i>	<i>osteosperma</i>			Cupressaceae	BHC
<i>Juniperus</i>	<i>scopulorum</i>			Cupressaceae	BHC
<i>Kelseya</i>	<i>uniflora</i>			Rosaceae	not collected/unknown
<i>Kochia</i>	<i>scoparia</i>			Chenopodiaceae	false report
<i>Koeleria</i>	<i>macrantha</i>			Poaceae	BHC
<i>Lactuca</i>	<i>ludoviciana</i>			Asteraceae	BHC
<i>Lactuca</i>	<i>oblongifolia</i>			Asteraceae	BHC
<i>Lactuca</i>	<i>serriola</i>			Asteraceae	BHC
<i>Lappula</i>	<i>cenchrusoides</i>			Boraginaceae	BHC
<i>Lappula</i>	<i>redowskii</i>			Boraginaceae	BHC
<i>Lappula</i>	<i>texana</i>			Boraginaceae	BHC
<i>Lepidium</i>	<i>densiflorum</i>			Brassicaceae	BHC
<i>Lepidium</i>	<i>perfoliatum</i>			Brassicaceae	BHC
<i>Leptodactylon</i>	<i>caespitosum</i>			Polemoniaceae	BHC
<i>Leptodactylon</i>	<i>pungens</i>			Polemoniaceae	BHC
<i>Lesquerella</i>	<i>alpina</i>			Brassicaceae	BHC
<i>Lesquerella</i>	<i>arenosa</i>			Brassicaceae	BHC
<i>Lesquerella</i>	<i>lesicii</i>			Brassicaceae	BHC 1712
<i>Lesquerella</i>	<i>ludoviciana</i>			Brassicaceae	BHC
<i>Leucocrinum</i>	<i>montanum</i>			Liliaceae	not collected/unknown
<i>Leucopoa</i>	<i>kingii</i>			Poaceae	BHC
<i>Lewisia</i>	<i>rediviva</i>			Portulacaceae	BHC
<i>Liatris</i>	<i>punctata</i>			Asteraceae	BHC
<i>Ligusticum</i>	<i>porteri</i>			Apiaceae	false report
<i>Lilium</i>	<i>philadelphicum</i>	var.	<i>andinum</i>	Liliaceae	not collected/unknown
<i>Linanthus</i>	<i>septentrionalis</i>			Polemoniaceae	not collected/unknown
<i>Linum</i>	<i>lewisii</i>			Linaceae	Knight plot
<i>Linum</i>	<i>rigidum</i>			Linaceae	BHC Lichvar, MONTU 1736
<i>Lithophragma</i>	<i>parviflorum</i>			Saxifragaceae	BHC
<i>Lithospermum</i>	<i>incisum</i>			Boraginaceae	BHC
<i>Lithospermum</i>	<i>ruderales</i>			Boraginaceae	BHC
<i>Logfia</i>	<i>arvensis</i>			Asteraceae	BHC
<i>Lomatium</i>	<i>cous</i>			Apiaceae	BHC
<i>Lomatium</i>	<i>dissectum</i>	var.	<i>multifidum</i>	Apiaceae	BHC
<i>Lomatium</i>	<i>foeniculaceum</i>			Apiaceae	BHC
<i>Lomatium</i>	<i>orientale</i>			Apiaceae	BHC
<i>Lomatium</i>	<i>triternatum</i>	ssp.	<i>platycarpum</i>	Apiaceae	not collected/unknown
<i>Lonicera</i>	<i>utahensis</i>			Caprifoliaceae	misid?
<i>Lupinus</i>	<i>argenteus</i>	ssp.	<i>argenteus</i>	Fabaceae	BHC
<i>Lupinus</i>	<i>pusillus</i>			Fabaceae	BHC
<i>Lupinus</i>	<i>pusillus</i>			Fabaceae	BHC
<i>Lupinus</i>	<i>sericeus</i>			Fabaceae	misid?

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<i>Genus</i>	<i>Species</i>	<i>ssp. or variety</i>		<i>Family</i>	<i>Specimen</i>
<i>Lupinus</i>	<i>wyethii</i>			Fabaceae	BHC
<i>Lychnis</i>	<i>alba</i>			Caryophyllaceae	not collected/unknown
<i>Lycopus</i>	<i>asper</i>			Lamiaceae	Knight plot
<i>Lygodesmia</i>	<i>juncea</i>			Asteraceae	BHC
<i>Lysimachia</i>	<i>ciliata</i>			Primulaceae	BHC
<i>Machaeranthera</i>	<i>canescens</i>			Asteraceae	BHC
<i>Machaeranthera</i>	<i>grindelioides</i>	var.	<i>grindelioides</i>	Asteraceae	BHC
<i>Machaeranthera</i>	<i>tanacetifolia</i>			Asteraceae	BHC
<i>Mahonia</i>	<i>repens</i>			Berberidaceae	BHC
<i>Malacothrix</i>	<i>sonchoides</i>			Asteraceae	BHC
<i>Malacothrix</i>	<i>torreyi</i>			Asteraceae	not collected/unknown
<i>Malcolmia</i>	<i>africana</i>			Brassicaceae	not collected/unknown
<i>Malva</i>	<i>parviflora</i>			Malvaceae	not collected/unknown
<i>Medicago</i>	<i>lupulina</i>			Fabaceae	BHC
<i>Medicago</i>	<i>sativa</i>			Fabaceae	BHC
<i>Melica</i>	<i>subulata</i>			Poaceae	BHC
<i>Melilotus</i>	<i>alba</i>			Fabaceae	BHC
<i>Melilotus</i>	<i>officinalis</i>			Fabaceae	BHC
<i>Mentha</i>	<i>arvensis</i>			Lamiaceae	BHC
<i>Mentha</i>	<i>canadensis</i>			Lamiaceae	BHC
<i>Mentzelia</i>	<i>albicaulis</i>			Loasaceae	BHC
<i>Mentzelia</i>	<i>decapetala</i>			Loasaceae	BHC
<i>Mentzelia</i>	<i>montana</i>			Loasaceae	BHC
<i>Mentzelia</i>	<i>nuda</i>			Loasaceae	misid?
<i>Mentzelia</i>	<i>pumila</i>			Loasaceae	MONTU
<i>Mertensia</i>	<i>ciliata</i>			Boraginaceae	BHC
<i>Mertensia</i>	<i>oblongifolia</i>			Boraginaceae	BHC
<i>Mertensia</i>	<i>viridis</i>			Boraginaceae	not collected/unknown
<i>Microseris</i>	<i>nutans</i>			Asteraceae	BHC
<i>Mimulus</i>	<i>guttatus</i>			Scrophulariaceae	BHC
<i>Mimulus</i>	<i>suksdorfii</i>			Scrophulariaceae	not collected/unknown
<i>Mirabilis</i>	<i>linearis</i>			Nyctaginaceae	BHC
<i>Monarda</i>	<i>fistulosa</i>			Lamiaceae	BHC
<i>Monolepis</i>	<i>nuttalliana</i>			Chenopodiaceae	BHC
<i>Muhlenbergia</i>	<i>asperifolia</i>			Poaceae	BHC, MONTU 1934
<i>Muhlenbergia</i>	<i>cuspidata</i>			Poaceae	MT-obs.
<i>Muhlenbergia</i>	<i>filiformis</i>			Poaceae	MONTU 1732
<i>Muhlenbergia</i>	<i>racemosa</i>			Poaceae	BHC
<i>Muhlenbergia</i>	<i>richardsoni</i>			Poaceae	BHC, MONTU 1727
<i>Musineon</i>	<i>divaricatum</i>			Apiaceae	BHC
<i>Musineon</i>	<i>vaginatum</i>			Apiaceae	BHC
<i>Nama</i>	<i>densum</i>			Hydrophyllaceae	BHC
<i>Nasturtium</i>	<i>officinale</i>			Brassicaceae	BHC
<i>Nepeta</i>	<i>cataria</i>			Lamiaceae	not collected/unknown
<i>Nothocalais</i>	<i>nutans</i>			Asteraceae	BHC; not <i>N. cuspidata</i>
<i>Nothocalais</i>	<i>nutans</i>			Asteraceae	Knight plot
<i>Oenothera</i>	<i>albicaulis</i>			Onagraceae	misid?
<i>Oenothera</i>	<i>cespitosa</i>			Onagraceae	BHC
<i>Oenothera</i>	<i>depressa</i>			Onagraceae	BHC
<i>Oenothera</i>	<i>pallida</i>			Onagraceae	BHC

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<i>Genus</i>	<i>Species</i>	<i>ssp. or variety</i>		<i>Family</i>	<i>Specimen</i>
<i>Oenothera</i>	<i>pallida</i>	ssp.	<i>trichocalyx</i>	Onagraceae	BHC
<i>Oenothera</i>	<i>villosa</i>	var.	<i>villosa</i>	Onagraceae	MT-obs.
<i>Onosmodium</i>	<i>molle</i>	var.	<i>occidentale</i>	Boraginaceae	BHC
<i>Opuntia</i>	<i>polyacantha</i>			Cactaceae	BHC
<i>Orobanche</i>	<i>fasciculata</i>			Orobanchaceae	BHC
<i>Orobanche</i>	<i>ludoviciana</i>			Orobanchaceae	MT-obs.
<i>Orobanche</i>	<i>uniflora</i>			Orobanchaceae	BHC
<i>Orthocarpus</i>	<i>luteus</i>			Scrophulariaceae	BHC
<i>Oryzopsis</i>	<i>hymenoides</i>			Poaceae	BHC
<i>Oryzopsis</i>	<i>micrantha</i>			Poaceae	BHC
<i>Osmorhiza</i>	<i>chilensis</i>			Apiaceae	BHC
<i>Osmorhiza</i>	<i>depauperata</i>			Apiaceae	Lichvar
<i>Osmorhiza</i>	<i>longistylis</i>			Apiaceae	BHC
<i>Oxytropis</i>	<i>besseyi</i>	var.	<i>besseyi</i>	Fabaceae	RM 1718
<i>Oxytropis</i>	<i>besseyi</i>	var.	<i>fallax</i>	Fabaceae	RM 1833
<i>Oxytropis</i>	<i>besseyi</i>	var.	<i>ventosa</i>	Fabaceae	RM
<i>Oxytropis</i>	<i>campestris</i>			Fabaceae	BHC
<i>Oxytropis</i>	<i>deflexa</i>			Fabaceae	not collected/unknown
<i>Oxytropis</i>	<i>lagopus</i>	var.	<i>lagopus</i>	Fabaceae	BHC
<i>Oxytropis</i>	<i>lagopus</i>			Fabaceae	BHC
<i>Oxytropis</i>	<i>sericea</i>			Fabaceae	misid?
<i>Parietaria</i>	<i>pensylvanica</i>			Urticaceae	BHC
<i>Parnassia</i>	<i>palustris</i>	var.	<i>montanensis</i>	Saxifragaceae	not collected/unknown
<i>Paronychia</i>	<i>sessiliflora</i>			Caryophyllaceae	BHC
<i>Pedicularis</i>	<i>cystopteridifolia</i>			Scrophulariaceae	BHC
<i>Pediocactus</i>	<i>simpsonii</i>			Cactaceae	BHC
<i>Pellaea</i>	<i>occidentalis</i>			Adiantaceae	BHC
<i>Penstemon</i>	<i>aridus</i>			Scrophulariaceae	not collected/unknown
<i>Penstemon</i>	<i>caryi</i>			Scrophulariaceae	BHC
<i>Penstemon</i>	<i>confertus</i>	var.	<i>procerus</i>	Scrophulariaceae	not collected/unknown
<i>Penstemon</i>	<i>eriantherus</i>			Scrophulariaceae	BHC
<i>Penstemon</i>	<i>glaber</i>			Scrophulariaceae	not collected/unknown
<i>Penstemon</i>	<i>humilis</i>	ssp.	<i>humilis</i>	Scrophulariaceae	misid?
<i>Penstemon</i>	<i>laricifolius</i>			Scrophulariaceae	BHC
<i>Penstemon</i>	<i>nitidus</i>			Scrophulariaceae	BHC
<i>Penstemon</i>	<i>procerus</i>			Scrophulariaceae	BHC
<i>Penstemon</i>	<i>procerus</i>			Scrophulariaceae	BHC
<i>Penstemon</i>	<i>radicosus</i>			Scrophulariaceae	BHC
<i>Perideridia</i>	<i>gairdneri</i>			Apiaceae	BHC
<i>Petalostemon</i>	<i>purpureus</i>			Fabaceae	BHC
<i>Petalostemum</i>	<i>candidum</i>			Fabaceae	BHC
<i>Petrophyton</i>	<i>caespitosum</i>			Rosaceae	BHC
<i>Phacelia</i>	<i>glandulifera</i>			Hydrophyllaceae	BHC
<i>Phacelia</i>	<i>glandulosa</i>			Hydrophyllaceae	not collected/unknown
<i>Phacelia</i>	<i>hastata</i>			Hydrophyllaceae	BHC
<i>Phacelia</i>	<i>ivesiana</i>			Hydrophyllaceae	BHC
<i>Phacelia</i>	<i>linearis</i>			Hydrophyllaceae	BHC
<i>Phacelia</i>	<i>sericea</i>			Hydrophyllaceae	not collected/unknown
<i>Phalaris</i>	<i>arundinacea</i>			Poaceae	BHC
<i>Phleum</i>	<i>pratense</i>			Poaceae	BHC
<i>Phlox</i>	<i>bryoides</i>			Polemoniaceae	BHC

Appendix B. Draft Update to the Flora of Bighorn Canyon National Recreation Area

<i>Genus</i>	<i>Species</i>	<i>ssp. or variety</i>		<i>Family</i>	<i>Specimen</i>
<i>Phlox</i>	<i>caespitosa</i>			Polemoniaceae	MONTU 1862
<i>Phlox</i>	<i>hoodii</i>			Polemoniaceae	BHC
<i>Phlox</i>	<i>longifolia</i>			Polemoniaceae	MT-obs.
<i>Phlox</i>	<i>multiflora</i>			Polemoniaceae	BHC
<i>Phragmites</i>	<i>australis</i>			Poaceae	BHC
<i>Physalis</i>	<i>heterophylla</i>			Solanaceae	BHC
<i>Physalis</i>	<i>longifolia</i>			Solanaceae	MT-obs.
<i>Physaria</i>	<i>acutifolia</i>			Brassicaceae	BHC
<i>Physaria</i>	<i>didymocarpa</i>	var.	<i>didymocarpa</i>	Brassicaceae	BHC
<i>Physocarpus</i>	<i>malvaceus</i>			Rosaceae	misid?
<i>Physocarpus</i>	<i>monogynus</i>			Rosaceae	BHC
<i>Picea</i>	<i>engelmannii</i>			Pinaceae	Lichvar
<i>Picradeniopsis</i>	<i>oppositifolia</i>			Asteraceae	Lichvar
<i>Pinus</i>	<i>flexilis</i>			Pinaceae	BHC
<i>Pinus</i>	<i>ponderosa</i>			Pinaceae	BHC
<i>Piperia</i>	<i>unalascensis</i>			Orchidaceae	BHC
<i>Plantago</i>	<i>major</i>			Plantaginaceae	not collected/unknown
<i>Plantago</i>	<i>patagonica</i>			Plantaginaceae	BHC
<i>Platanthera</i>	<i>dilatata</i>			Orchidaceae	BHC
<i>Platanthera</i>	<i>hyperborea</i>			Orchidaceae	BHC, MONTU
<i>Platyschkuhria</i>	<i>integrifolia</i>			Asteraceae	BHC
<i>Poa</i>	<i>alpina</i>			Poaceae	BHC
<i>Poa</i>	<i>annua</i>			Poaceae	BHC 1850
<i>Poa</i>	<i>arida</i>			Poaceae	not collected/unknown
<i>Poa</i>	<i>bulbosa</i>			Poaceae	BHC
<i>Poa</i>	<i>compressa</i>			Poaceae	BHC
<i>Poa</i>	<i>cusickii</i>			Poaceae	BHC
<i>Poa</i>	<i>fendleriana</i>			Poaceae	not collected/unknown
<i>Poa</i>	<i>glaucifolia</i>			Poaceae	BHC
<i>Poa</i>	<i>interior</i>			Poaceae	BHC
<i>Poa</i>	<i>pratensis</i>			Poaceae	BHC
<i>Poa</i>	<i>secunda</i>			Poaceae	BHC
<i>Polanisia</i>	<i>dodecandra</i>	ssp.	<i>trachysperma</i>	Capparaceae	BHC
<i>Polemonium</i>	<i>occidentale</i>	ssp.	<i>occidentale</i>	Polemoniaceae	not collected/unknown
<i>Polemonium</i>	<i>pulcherrimum</i>	ssp.	<i>pulcherrimum</i>	Polemoniaceae	not collected/unknown
<i>Polemonium</i>	<i>viscosum</i>			Polemoniaceae	not collected/unknown
<i>Polygonum</i>	<i>achoreum</i>			Polygonaceae	misid?
<i>Polygonum</i>	<i>aviculare</i>			Polygonaceae	BHC
<i>Polygonum</i>	<i>bistortoides</i>			Polygonaceae	BHC
<i>Polygonum</i>	<i>lapathifolium</i>			Polygonaceae	BHC
<i>Polypogon</i>	<i>monspeliensis</i>			Poaceae	BHC
<i>Polystichum</i>	<i>lonchitis</i>			Dryopteridaceae	BHC
<i>Populus</i>	<i>alba</i>			Salicaceae	BHC
<i>Populus</i>	<i>angustifolia</i>			Salicaceae	BHC
<i>Populus</i>	<i>deltoides</i>			Salicaceae	BHC
<i>Populus</i>	<i>tremuloides</i>			Salicaceae	BHC
<i>Populus</i>	<i>X acuminata</i>			Salicaceae	BHC
<i>Portulaca</i>	<i>oleracea</i>			Portulacaceae	not collected/unknown
<i>Potamogeton</i>	<i>filiformis</i>			Potamogetonaceae	BHC
<i>Potentilla</i>	<i>anserina</i>			Rosaceae	not collected/unknown
<i>Potentilla</i>	<i>biennis</i>			Rosaceae	BHC

Appendix B. Draft Update to the Flora of Bighorn Canyon National Recreation Area

<i>Genus</i>	<i>Species</i>	<i>ssp. or variety</i>		<i>Family</i>	<i>Specimen</i>
<i>Potentilla</i>	<i>diversifolia</i>	var.	<i>diversifolia</i>	Rosaceae	BHC
<i>Potentilla</i>	<i>fissa</i>			Rosaceae	not collected/unknown
<i>Potentilla</i>	<i>fruticosa</i>			Rosaceae	BHC
<i>Potentilla</i>	<i>gracilis</i>	var.	<i>glabrata</i>	Rosaceae	BHC
<i>Potentilla</i>	<i>norvegica</i>			Rosaceae	BHC
<i>Potentilla</i>	<i>ovina</i>			Rosaceae	BHC
<i>Potentilla</i>	<i>paradoxa</i>			Rosaceae	BHC
<i>Potentilla</i>	<i>pennsylvanica</i>			Rosaceae	BHC
<i>Prunella</i>	<i>vulgaris</i>			Lamiaceae	MT-obs.
<i>Prunus</i>	<i>americana</i>			Rosaceae	BHC
<i>Prunus</i>	<i>virginiana</i>	var.	<i>melanocarpa</i>	Rosaceae	BHC
<i>Pseudotsuga</i>	<i>menziesii</i>			Pinaceae	BHC
<i>Psoralea</i>	<i>esculenta</i>			Fabaceae	BHC
<i>Psoralea</i>	<i>lanceolata</i>			Fabaceae	BHC
<i>Psoralea</i>	<i>tenuiflora</i>			Fabaceae	BHC
<i>Pteryxia</i>	<i>terebinthina</i>	var.	<i>calcareae</i>	Apiaceae	not collected/unknown
<i>Pyrola</i>	<i>asarifolia</i>			Pyrolaceae	not collected/unknown
<i>Pyrola</i>	<i>secunda</i>			Pyrolaceae	not collected/unknown
<i>Ranunculus</i>	<i>cymbalaria</i>	var.	<i>cymbalaria</i>	Ranunculaceae	BHC
<i>Ranunculus</i>	<i>gmelinii</i>			Ranunculaceae	MONTU 1715
<i>Ranunculus</i>	<i>macounii</i>			Ranunculaceae	BHC
<i>Ranunculus</i>	<i>pennsylvanicus</i>			Ranunculaceae	BHC
<i>Ranunculus</i>	<i>testiculatus</i>			Ranunculaceae	BHC
<i>Ranunculus</i>	<i>uncinatus</i>	var.	<i>uncinatus</i>	Ranunculaceae	BHC
<i>Ratibida</i>	<i>columnifera</i>			Asteraceae	BHC
<i>Rhus</i>	<i>glabra</i>			Anacardiaceae	BHC
<i>Rhus</i>	<i>trilobata</i>			Anacardiaceae	BHC
<i>Ribes</i>	<i>americanum</i>			Grossulariaceae	BHC
<i>Ribes</i>	<i>aureum</i>			Grossulariaceae	BHC
<i>Ribes</i>	<i>cereum</i>			Grossulariaceae	BHC
<i>Ribes</i>	<i>setosum</i>			Grossulariaceae	BHC
<i>Rorippa</i>	<i>calycina</i>			Brassicaceae	BHC
<i>Rorippa</i>	<i>curvipes</i>			Brassicaceae	BHC
<i>Rorippa</i>	<i>curvipes</i>	var.	<i>curvipes</i>	Brassicaceae	BHC
<i>Rorippa</i>	<i>palustris</i>	var.	<i>hispida</i>	Brassicaceae	RM 18414
<i>Rorippa</i>	<i>sinuata</i>			Brassicaceae	BHC
<i>Rosa</i>	<i>acicularis</i>	ssp.	<i>sayi</i>	Rosaceae	not collected/unknown
<i>Rosa</i>	<i>sayi</i>			Rosaceae	BHC
<i>Rosa</i>	<i>woodsii</i>			Rosaceae	HC
<i>Rubus</i>	<i>idaeus</i>	var.	<i>gracilipes</i>	Rosaceae	BHC
<i>Rubus</i>	<i>idaeus</i>			Rosaceae	BHC
<i>Rudbeckia</i>	<i>hirta</i>			Asteraceae	BHC
<i>Rudbeckia</i>	<i>laciniata</i>	var.	<i>ampla</i>	Asteraceae	Lichvar
<i>Rumex</i>	<i>crispus</i>			Polygonaceae	BHC
<i>Rumex</i>	<i>maritimus</i>			Polygonaceae	Knight plot
<i>Rumex</i>	<i>rubrum</i>			Polygonaceae	Knight plot
<i>Rumex</i>	<i>triangulivalvis</i>			Polygonaceae	not collected/unknown
<i>Rumex</i>	<i>venosus</i>			Polygonaceae	BHC
<i>Salix</i>	<i>amygdaloides</i>			Salicaceae	BHC
<i>Salix</i>	<i>bebbiana</i>			Salicaceae	MONTU 1709
<i>Salix</i>	<i>boothii</i>			Salicaceae	BHC

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<i>Genus</i>	<i>Species</i>	<i>ssp. or variety</i>		<i>Family</i>	<i>Specimen</i>
<i>Salix</i>	<i>drummondiana</i>			Salicaceae	BHC
<i>Salix</i>	<i>exigua</i>			Salicaceae	BHC
<i>Salix</i>	<i>lutea</i>			Salicaceae	BHC
<i>Salix</i>	<i>monticola</i>			Salicaceae	BHC
<i>Salsola</i>	<i>kali</i>			Chenopodiaceae	BHC
<i>Sambucus</i>	<i>canadensis</i>			Caprifoliaceae	BHC
<i>Sambucus</i>	<i>cerulea</i>			Caprifoliaceae	BHC
<i>Sambucus</i>	<i>racemosa</i>	ssp.	<i>pubens</i>	Caprifoliaceae	not collected/unknown
<i>Sanicula</i>	<i>marilandica</i>			Apiaceae	BHC
<i>Sarcobatus</i>	<i>vermiculatus</i>			Chenopodiaceae	BHC
<i>Saxifraga</i>	<i>rhomboidea</i>			Saxifragaceae	BHC
<i>Schizachne</i>	<i>paniculatus</i>			Poaceae	MT-obs.
<i>Schizachyrium</i>	<i>scoparium</i>	var.	<i>scoparium</i>	Poaceae	BHC
<i>Scirpus</i>	<i>acutus</i>			Cyperaceae	Knight plot
<i>Scirpus</i>	<i>maritimus</i>			Cyperaceae	Knight plot
<i>Scirpus</i>	<i>pallidus</i>			Cyperaceae	BHC
<i>Scirpus</i>	<i>pungens</i>			Cyperaceae	not collected/unknown
<i>Scirpus</i>	<i>validus</i>			Cyperaceae	BHC
<i>Scutellaria</i>	<i>galericulata</i>			Lamiaceae	BHC
<i>Sedum</i>	<i>lanceolatum</i>			Crassulaceae	BHC
<i>Selaginella</i>	<i>densa</i>			Selaginellaceae	BHC
<i>Senecio</i>	<i>canus</i>			Asteraceae	BHC
<i>Senecio</i>	<i>cymbalarioides</i>			Asteraceae	MONTU 1733
<i>Senecio</i>	<i>eremophilus</i>	var	<i>eremophilus</i>	Asteraceae	BHC
<i>Senecio</i>	<i>integerrimus</i>			Asteraceae	BHC
<i>Senecio</i>	<i>pauperculus</i>			Asteraceae	MONTU 1853
<i>Senecio</i>	<i>plattensis</i>			Asteraceae	BHC
<i>Senecio</i>	<i>pseudoaureus</i>			Asteraceae	MONTU 1922
<i>Senecio</i>	<i>serra</i>			Asteraceae	Lichvar
<i>Senecio</i>	<i>streptanthifolius</i>			Asteraceae	Lichvar
<i>Setaria</i>	<i>viridis</i>			Poaceae	not collected/unknown
<i>Shepherdia</i>	<i>argentea</i>			Elaeagnaceae	not collected/unknown
<i>Shepherdia</i>	<i>canadensis</i>			Elaeagnaceae	BHC
<i>Silene</i>	<i>antirrhina</i>			Caryophyllaceae	MT - obs.
<i>Silene</i>	<i>menziesii</i>			Caryophyllaceae	BHC
<i>Sisymbrium</i>	<i>altissimum</i>			Brassicaceae	BHC
<i>Sisymbrium</i>	<i>linifolium</i>			Brassicaceae	BHC
<i>Sisymbrium</i>	<i>loeselii</i>			Brassicaceae	not collected/unknown
<i>Sisyrinchium</i>	<i>angustifolium</i>			Iridaceae	BHC
<i>Sisyrinchium</i>	<i>idahoense</i>			Iridaceae	BHC, MONTU 1817
<i>Sisyrinchium</i>	<i>montanum</i>			Iridaceae	not collected/unknown
<i>Sitanion</i>	<i>hystrix</i>			Poaceae	BHC
<i>Smelowskia</i>	<i>calycina</i>	var.	<i>americana</i>	Brassicaceae	not collected/unknown
<i>Smilacina</i>	<i>racemosa</i>			Liliaceae	BHC
<i>Smilacina</i>	<i>stellata</i>			Liliaceae	not collected/unknown
<i>Smilax</i>	<i>herbacea</i>			Smilacaceae	BHC
<i>Solanum</i>	<i>dulcamara</i>			Solanaceae	BHC
<i>Solanum</i>	<i>triflorum</i>			Solanaceae	not collected/unknown
<i>Solidago</i>	<i>canadensis</i>			Asteraceae	BHC
<i>Solidago</i>	<i>canadensis</i>	var.	<i>salebrosa</i>	Asteraceae	BHC
<i>Solidago</i>	<i>gigantea</i>	var.	<i>serotina</i>	Asteraceae	Lichvar

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<i>Genus</i>	<i>Species</i>	<i>ssp. or variety</i>		<i>Family</i>	<i>Specimen</i>
<i>Solidago</i>	<i>missouriensis</i>			Asteraceae	BHC
<i>Solidago</i>	<i>missouriensis</i>	var.	<i>extraria</i>	Asteraceae	BHC
<i>Solidago</i>	<i>rigida</i>	var.	<i>humilis</i>	Asteraceae	BHC
<i>Solidago</i>	<i>spatulata</i>	var.	<i>nana</i>	Asteraceae	BHC
<i>Sonchus</i>	<i>asper</i>			Asteraceae	BHC
<i>Sonchus</i>	<i>oleraceus</i>			Asteraceae	misid?
<i>Sonchus</i>	<i>uliginosus</i>			Asteraceae	BHC
<i>Spartina</i>	<i>gracilis</i>			Poaceae	BHC, MONTU 1726
<i>Spartina</i>	<i>pectinata</i>			Poaceae	not collected/unknown
<i>Spergularia</i>	<i>marina</i>			Caryophyllaceae	Knight plot
<i>Sphaeralcea</i>	<i>coccinea</i>			Malvaceae	BHC
<i>Sphaeromeria</i>	<i>capitata</i>			Asteraceae	BHC
<i>Sphaerophysa</i>	<i>salsula</i>			Fabaceae	BHC
<i>Sphenopholis</i>	<i>obtusata</i>	var.	<i>major</i>	Poaceae	RM
<i>Spiraea</i>	<i>betulifolia</i>			Rosaceae	BHC
<i>Sporobolus</i>	<i>airoides</i>			Poaceae	BHC
<i>Sporobolus</i>	<i>cryptandrus</i>			Poaceae	BHC
<i>Stachys</i>	<i>palustris</i>	var.	<i>pilosa</i>	Lamiaceae	not collected/unknown
<i>Stanleya</i>	<i>pinnata</i>			Brassicaceae	not collected/unknown
<i>Stanleya</i>	<i>tomentosa</i>	var.	<i>tomentosa</i>	Brassicaceae	BHC
<i>Stellaria</i>	<i>media</i>			Caryophyllaceae	BHC
<i>Stephanomeria</i>	<i>runcinata</i>			Asteraceae	BHC
<i>Stephanomeria</i>	<i>tenuiflora</i>			Asteraceae	BHC 1928
<i>Stipa</i>	<i>columbiana</i>			Poaceae	BHC
<i>Stipa</i>	<i>comata</i>			Poaceae	BHC
<i>Stipa</i>	<i>lettermanii</i>			Poaceae	BHC
<i>Stipa</i>	<i>nelsonii</i>			Poaceae	MT-obs.
<i>Stipa</i>	<i>viridula</i>			Poaceae	BHC
<i>Stipa</i>	<i>williamsii</i>			Poaceae	not collected/unknown
<i>Streptanthella</i>	<i>longirostris</i>			Brassicaceae	BHC
<i>Suaeda</i>	<i>fruticosa</i>			Chenopodiaceae	not collected/unknown
<i>Suaeda</i>	<i>torreyana</i>			Chenopodiaceae	BHC
<i>Suckleya</i>	<i>suckleyana</i>			Chenopodiaceae	Knight plot
<i>Sullivantia</i>	<i>hapemanii</i>	var.	<i>hapemanii</i>	Saxifragaceae	BHC
<i>Symphoricarpos</i>	<i>albus</i>	var.	<i>albus</i>	Caprifoliaceae	BHC
<i>Symphoricarpos</i>	<i>albus</i>			Caprifoliaceae	BHC
<i>Symphoricarpos</i>	<i>occidentalis</i>			Caprifoliaceae	BHC
<i>Symphoricarpos</i>	<i>oreophilus</i>	var.	<i>utahensis</i>	Caprifoliaceae	not collected/unknown
<i>Tamarix</i>	<i>chinensis</i>			Tamaricaceae	BHC
<i>Tanacetum</i>	<i>vulgare</i>			Asteraceae	BHC 1927
<i>Taraxacum</i>	<i>laevigatum</i>			Asteraceae	BHC
<i>Taraxacum</i>	<i>officinale</i>			Asteraceae	not collected/unknown
<i>Tetradymia</i>	<i>canescens</i>			Asteraceae	BHC
<i>Tetradymia</i>	<i>spinosa</i>			Asteraceae	not collected/unknown
<i>Thalictrum</i>	<i>dasycarpum</i>			Ranunculaceae	BHC
<i>Thalictrum</i>	<i>fendleri</i>			Ranunculaceae	BJC
<i>Thalictrum</i>	<i>occidentale</i>			Ranunculaceae	misid?
<i>Thermopsis</i>	<i>rhombifolia</i>			Fabaceae	BHC
<i>Thlaspi</i>	<i>arvense</i>			Brassicaceae	BHC
<i>Townsendia</i>	<i>hookeri</i>			Asteraceae	BHC
<i>Townsendia</i>	<i>incana</i>			Asteraceae	BHC

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<i>Genus</i>	<i>Species</i>	<i>ssp. or variety</i>		<i>Family</i>	<i>Specimen</i>
<i>Townsendia</i>	<i>parryi</i>			Asteraceae	BHC
<i>Townsendia</i>	<i>spathulata</i>			Asteraceae	BHC
<i>Toxicodendron</i>	<i>rydbergii</i>			Anacardiaceae	BHC
<i>Tradescantia</i>	<i>bracteata</i>			Commelinaceae	not collected/unknown
<i>Tradescantia</i>	<i>occidentalis</i>			Commelinaceae	BHC
<i>Tragopogon</i>	<i>dubius</i>			Asteraceae	BHC
<i>Trifolium</i>	<i>hybridum</i>			Fabaceae	BHC
<i>Trifolium</i>	<i>pratense</i>			Fabaceae	not collected/unknown
<i>Triglochin</i>	<i>maritimum</i>			Juncaginaceae	MONTU 1858
<i>Triglochin</i>	<i>palustre</i>			Juncaginaceae	MONTU 1723
<i>Triodanis</i>	<i>leptocarpa</i>			Campanulaceae	not collected/unknown
<i>Triodanis</i>	<i>perfoliata</i>	var.	<i>perfoliata</i>	Campanulaceae	not collected/unknown
<i>Trisetum</i>	<i>spicatum</i>			Poaceae	not collected/unknown
<i>Typha</i>	<i>angustifolia</i>			Typhaceae	BHC
<i>Typha</i>	<i>latifolia</i>			Typhaceae	BHC
<i>Ulmus</i>	<i>pumila</i>			Ulmaceae	BHC
<i>Urtica</i>	<i>dioica</i>			Urticaceae	not collected/unknown
<i>Utricularia</i>	<i>vulgaris</i>			Lentibulariaceae	not collected/unknown
<i>Valeriana</i>	<i>dioica</i>			Valerianaceae	BHC
<i>Valeriana</i>	<i>edulis</i>			Valerianaceae	BHC
<i>Verbascum</i>	<i>thapsus</i>			Scrophulariaceae	not collected/unknown
<i>Verbena</i>	<i>bracteata</i>			Verbenaceae	BHC
<i>Verbena</i>	<i>hastata</i>			Verbenaceae	not collected/unknown
<i>Veronica</i>	<i>americana</i>			Scrophulariaceae	BHC
<i>Veronica</i>	<i>anagallis-aquatica</i>			Scrophulariaceae	Knight plot
<i>Veronica</i>	<i>peregrina</i>	var.	<i>xalapensis</i>	Scrophulariaceae	BHC
<i>Vicia</i>	<i>americana</i>			Fabaceae	BHC
<i>Viola</i>	<i>adunca</i>	var.	<i>adunca</i>	Violaceae	BHC
<i>Viola</i>	<i>canadensis</i>	var.	<i>canadensis</i>	Violaceae	BHC
<i>Viola</i>	<i>nuttallii</i>			Violaceae	BHC
<i>Viola</i>	<i>palustris</i>			Violaceae	MONTU 1826
<i>Viola</i>	<i>vallicola</i>			Violaceae	BHC
<i>Vitis</i>	<i>riparia</i>			Vitaceae	BHC
<i>Woodsia</i>	<i>scopulina</i>			Polypodiaceae	BHC
<i>Wyethia</i>	<i>scabra</i>			Asteraceae	BHC
<i>Xanthium</i>	<i>strumarium</i>			Asteraceae	BHC
<i>Xylorhiza</i>	<i>glabriuscula</i>			Asteraceae	BHC
<i>Yucca</i>	<i>glauc</i>	var.	<i>glauc</i>	Agavaceae	BHC
<i>Zigadenus</i>	<i>elegans</i>			Liliaceae	BHC
<i>Zigadenus</i>	<i>venosus</i>			Liliaceae	BHC